Aviation Rulemaking Advisory Committee
Executive Committee
Meeting Summary

DATE: August 8, 2001

LOCATION: Holiday Inn--Capitol
550 C Street, Columbia Room
Washington, DC

PUBLIC ANNOUNCEMENT: The FAA informed the public of this meeting in Federal Register notices published on July 2, (66 FR 34982) and August 7, 2001, (66 FR 41290).

ATTENDEES:

Ron Priddy	NACA
Jim Hurd	NADA/F
Tony Fazio	FAA
Dave Hilton	Gulf Stream
Gerri Robinson	FAA
Glenn Rizner	HAI
Al Prest	ATA
Edmund Boullay	JAA
Don Byrne	FAA/AGC
Ken Susko	ASFC
Sarah MacLeod	ARSA
Thomas Kunjachan	BOC Gases
Ian Redhead	AAAE
Sylvia Adcock	Newsday
Ida Klepper	FAA
Nan Shellabarger	FAA
Chris Lynch	DHM, Inc.
John Tigue	Raytheon
Marc L. Valle	DFJC
Norm Joseph	ADF
John Swihart	HAI
Bill Schultz	GAMA
C.W. Kauffman	NADA/F
Paul Hudson	ACAP
Don Collier	EM&M Air Transport Assn.
Jonathan D. Slart	Associated Press
John Cauley	
Don Bianco	Cronus Consulting
Tim Neale	Boeing
Alison Druquette	FAA
Peter Kiernan	Energy Intelligence Group
John Hughes	Bloomberg
Joseph Kolly	NTSB
Greg Haack	On-Board Design Task Team Leader
Allen Mattes	FAA
Frank O'Neill	United Airlnes (ATA)
Michael Collins	FAA
Jerry Mack	Boeing
Dennis Floyd	Boeing
Karl Beers	Air Liguide
David Marchese	Air Liquide

Lonnie Richards	Airbus, UK
Anne Jany	Airbus
Dan DeWitt	Northwest Airlines
David Evans	PBI Media
Alan Levin	USAT
Tomoko Sekiyn	FAA
Jennifer Banks	ACI-NA
Sean Kent	Raytheon
Florence hamn	FAA
Sean O'Callaghan	British Airways
Brad Moravec	Boeing

Telecon:

Billy Glover	Boeing
Craig Bolt	Pratt & Whitney
Bill Edmunds	ALPA

MEETING SUMMARY

- Al Prest, Chair, called the meeting to order at 10:05 a.m. He thanked all the participants for the role they play in making ARAC a success.
- Tony Fazio, the Aviation Rulemaking Advisory Committee (ARAC) Executive Director, read the Federal Advisory Committee Act (FACA) statement.
- Mr. Prest introduced the Vice Chair, Glenn Rizner, and the Executive Committee (EXCOM) members seated at the meeting table introduced themselves.

Review and Approval of Minutes of Previous Meeting

The EXCOM members reviewed the minutes from the April 4, 2001, meeting. There was a motion to accept the minutes. The motion was approved and the minutes were adopted.

Status Report: Fuel Tank Inerting Working Group

- Al Prest introduced Brad Moravac and Sean O'Callaghan, the working group co-chairs. Before beginning the briefing, Mr. Moravac introduced the members of the working group who were present. Mr. Moravac asked the EXCOM members to please hold all questions until the end of the briefing. EXCOM agreed and decided they would take the time necessary at the end of the briefing to address all concerns and questions.
- Mr. O' Callagan proceeded with the technical phase of the briefing and discussed the task background, the tasking statement, the working group formation, milestones, and report summary. He explained the working group evaluated many proposals for reducing the flammability of fuel tanks by using inert gas--Ground-Based Inerting (GBI), Onboard Ground Inerting (OBGI), Onboard Inert Gas Generating Systems (OBIGGS), and derivative combinations of OBGI and OBIGGS--described as "Hybrid Systems". As he worked through each concept, he explained the system, presented the advantages and disadvantages, and the technical limits. During the report summary, he discussed fleet-wide flammability exposure, accident avoidance, inerting hazards, cost benefits, and worldwide implementation.
- Mr. Moravac discussed the Sensitivity Analysis prepared to address the Working Group's questions and assumptions used in the study. He stated the Sensitivity Analysis evaluated the effects of SFAR 88 benefits, labor hours and labor productivity, number of airports with an inerting systems installed, airplane operation data, delay costs, retrofit implementation, and ground vs. in-flight accident rates. He concluded that none of the effects, or combination of effects, were sufficient to change the

working group's conclusions or recommendations. Mr. Fazio recommended the Sensitive Analysis be included in the body of the final report, not as an appendix. He also requested it be addressed in the executive summary. The working group agreed to this change. Mr. Moravac ended the briefing with the following conclusions and recommendations of the working group.

- Evaluate a means to reduce fuel tank flammability based on existing or new technology that might be introduced sooner than an inerting system.
- Initiate a project that would improve and substantiate current flammability and ignitability analyses to better predict when airplane fuel-tank ullage mixtures are flammable. (This research is needed to support informed design decisions and rulemaking.)
- Initiate a project to thoroughly document and substantiate the flammability model used in the study.

A copy of the presentation and executive summary is attached. A CD that contains the working group's complete report is included in the official ARAC files.

Al Prest thanked the group for their extensive and expansive effort and inquired if an environmental impact study was part of the working group's task. The working group did not conduct a true environmental impact study.

The discussion then moved to the cost benefits analysis and the composition of the multi-team effort in completing the analysis. It was agreed the working group would provide EXCOM with the names and qualifications of the cost-benefit team participants. Mr. Redhead expressed concerns about environmental impact and the distinction between airport costs and airlines cost which seem to be missing from the report. He suggested the need for more studies about airport infrastructure and support, certification standards for airports, and liability studies because of the use of hazardous materials. Mr. Kauffman provided his concerns about passenger cost, negative impact vs. cost benefit, and the cost-benefit rations of 39:1 and 47:1. The group discussed these elements, and agreed there were many concerns and unanswered questions in this area.

Sarah MacLeod suggested rather than discuss the report issue by issue, the EXCOM accept the report as presented and EXCOM will direct the working group specifically how the final report should be structured. Paul Hudson raised a question of timing. Sarah explained, if the report is put in front of EXCOM, the members could digest it with a discussion and questions, and come up with action items before sending it to the FAA. A short discussion followed about the process EXCOM would take before sending the report to the FAA, and whether the report was a final report or a draft report. After determining it was the working group's final report, Sarah moved that EXCOM accept the final report, but not disband the working group.

After much discussion, EXCOM approved the following motion:

EXCOM agreed to review the final report from the Fuel Tank Working Group and not to disband the working group pending further instructions from EXCOM to modify the report with specific tasking.

To ensure adequate time to update the report based upon EXCOM comments, EXCOM agreed to the following schedule:

- 8/8 - 9/7: EXCOM to submit any specific concerns and/or issues about the "Final Report."
- 9/8 - 10/8: The working group to review EXCOM comments, modify the "Final Report" and issue another "Final Report (medium--CD Rom)
- 10-9 - 11/7: EXCOM to review the changed "Final Report" and include any minority views.

The Office of Rulemaking will act as the focal point and receive all the input regarding the report.

Sarah MacLeod asked that each member of the EXCOM be specific in their comments and designate the page and give specific wording about each concern. Al Prest asked each member of EXCOM to quantify each comment.

Mr. Prest ended this section of the agenda and thanked Mr. Moravac, Mr. O'Callaghan, and the members of the Fuel Tank Inerting Harmonization Working Group for all the work that was done.

At this time, Mr. Prest announced his tenure as EXCOM Chair would be ending. Mr. Rizner would be stepping into the chair's spot. Suggestions for the new vice chair should be send it to Mr. Fazio.

Status Reports

Each Assistant Chair gave a brief status report.

Miscellaneous

The EXCOM Committee agreed the next meeting is to be Nov. 7, 2001.
The Chair entertained a motion to adjourn the meeting. The motion was seconded and the August 8, 2001, meeting of EXCOM was adjourned.

Minutes approved and verified as accurate:
Al Prest, Chair
March 13, 2002

Minutes approved and verified as accurate
EXCOM meeting Date: August 8, 2001

AVIATION RULEMAKING ADVISORY COMMITTEE (ARAC)

FEDERAL AVIATION ADMINISTRATION

HOLIDAY INN "C" STREET

AUGUST 8, 2001

EXECUTIVE COMMITTEE MEETING - 10:00 a.m.

- Welcome and Introductions - Tony Fazio, Executive Director and Albert Prest, Chair
- Review and approval of previous meeting minutes
- Fuel Tank Inerting Working Group report
- Nominations for Vice Chair
- Status reports from Assistant Chairs
- Remarks from other Excom members
- Confirmation of next Excom meeting date: November 7, 2001

1.0 EXECUTIVE SUMMARY

1.1 OVERVIEW

This report presents the findings of the Aviation Rulemaking Advisory Committee (ARAC) Fuel Tank Inerting Harmonization Working Group (FTIHWG). The ARAC and its working groups cooperate to bring the expertise of the aviation industry, regulatory agencies, and public interest groups together to study specific subjects. The primary motivation of the FTIHWG is to save lives by enhancing airplane safety in an effective and practical manner.

The FAA tasked ARAC to provide a report recommending regulatory text and data needed by the FAA to evaluate options for new rulemaking requiring the elimination or significant reduction of flammable vapors through fuel tank inerting of transport-category airplanes. The FTIHWG studied several fuel tank inerting concepts. Fuel tank inerting is a method of reducing the oxygen concentration within fuel tanks to decrease the risk of explosions. Using methodology patterned after accepted FAA economic analysis practices, the FTIHWG found that none of these systems produced benefits, at present technology maturity levels, that were reasonably balanced by their costs.

The requested data is contained in this report. However, the FTIHWG is not recommending proposed regulatory text because this study was unable to identify any practical way of implementing the inerting designs studied.

Consequently, FTIHWG recommends that the FAA, NASA, and aviation industry conduct further research with an objective of developing more viable solutions for reducing fuel tank flammability much sooner than any of the inerting concepts evaluated could be implemented.

1.2 INTRODUCTION

The FTIHWG—the author of this report—has built upon the work of the 1998 Fuel Tank Harmonization Working Group (FTHWG), which assessed a broad range of methods to improve fuel tank safety through reduced flammability exposure. The FTHWG in its 1998 final report recommended that the FAA investigate further the feasibility of what it then identified as the two most promising methods:

- Directed ventilation.
- Fuel tank inerting.

The FAA chose to evaluate directed ventilation internally and tasked the ARAC with evaluating fuel tank inerting, leading to the formation of the FTIHWG. The FAA Tasking Statement requested that this HWG define and evaluate fuel tank inerting design concepts that would eliminate or significantly reduce the development of flammable vapors in fuel tanks. The FTIHWG was given 12 months to complete this assignment and prepare this final report.

Within this report is a comprehensive evaluation of the technical, safety, and economic merits of ground-based and onboard fuel tank inerting systems for in-service, current production, and new type design transport-category airplanes.

This ARAC study includes results of ongoing work being performed by the FAA under its internal fuel tank inerting research program. This FAA research covers the evaluation of the latest-available nitrogen generating technologies, research into fuel flammability, and various methods of inerting fuel tanks. Also covered in this report is the ground and flight-test program completed by the FAA and industry in early 2001, which provided essential data for this report.

Attachment 2

1.3 SYSTEMS EVALUATED

The three basic inerting design system concepts addressed by the FTIHWG are

- Ground-Based Inerting (GBI)—a system using ground-based nitrogen gas supply equipment to inert fuel tanks that are located near significant heat sources or that do not cool at a rate equivalent to unheated wing tanks. The affected fuel tanks would be inerted once the airplane reaches the gate and is on the ground between flights.

- Onboard Ground-Inerting (OBGI)—an onboard system that uses nitrogen gas generating equipment to inert fuel tanks that are located near significant heat sources or that do not cool at a rate equivalent to an unheated wing tank. The affected fuel tanks will be inerted while the airplane is on the ground between flights.

- Onboard Inert Gas Generating System (OBIGGS)—a system that uses onboard nitrogen gas generating equipment to inert all the fuel system's tanks so that they remain inert throughout normal ground and typical flight operations.

In addition to these three basic design concepts, derivative combinations of OBGI and OBIGGS were also studied. They are described as "hybrid systems" in this report.

1.4 FTIHWG STRUCTURE

To manage and accomplish the requirements established by the FAA Tasking Statement, the FTIHWG established three primary task teams:

- Ground-Based Inerting Design (GBI).
- Airport Facilities (for GBI).
- Onboard Inerting Design (OBGI, OBIGGS, hybrid systems).

In addition, five support task teams were created:

- Airplane Operations and Maintenance.
- Estimating and Forecasting.
- Safety.
- Rulemaking.
- Integration.

1.5 SCOPE AND ASSUMPTIONS

The overall mission of the FTIHWG has been to determine whether safety enhancement through fuel tank inerting systems is practical. If not, this body was asked to propose research programs that would lead to a practical system.

The task teams included representatives from U.S. and non-U.S. companies from a variety of fields (e.g., commercial airlines, major and general aviation manufacturers, petroleum refiners, industrial gas suppliers, public interest groups). These experts worked closely to devise a practical inerting system.

As defined in the Tasking Statement, the FTIHWG based its work on the assumption that the proposed fuel tank inerting systems are not considered flight critical and, therefore, airplanes may be dispatched with the system inoperative. This assumption is fundamental to the technical and cost conclusions of this report.

For the purposes of this study, it was assumed that the resources would be made available as needed to implement a desirable inerting system. Further studies would be needed to assess the effect of the unavailability of industrial capacity, personnel, or any other resources needed to implement an inerting system.

During the study period, some 70 experts spent more than 50,000 hr evaluating a large number of fuel tank inerting options and design concepts together with the effects these systems would have if implemented in the existing fleet as well as airplanes yet to be designed. Areas specifically evaluated for resultant effects were safety (measured in the anticipated preclusion of future accidents), regulation, airplane configuration, airport infrastructure, and flight and maintenance operations. Underlying this exhaustive effort were a single defined set of *study ground rules* that were used by all participants to ensure that each team worked consistently and was aware of the requirements in all other areas.

When completed, the above efforts yielded a detailed body of knowledge that allowed the FTIHWG to draw informed conclusions based on data and analysis. These conclusions and recommendations specifically address the technical limitations of inerting, its potential benefits and hazards, and the relative costs of implementing inerting versus its projected benefits (i.e., cost-benefit analysis) as described below and in the body of this report.

1.6 TECHNICAL EVALUATIONS

Figure 1-1 summarizes the technical evaluation of each of the inerting system concepts considered by the FTIHWG.

1. Ground-Based Inerting (GBI)

Concept

Center wing tanks (heated or unheated) and auxiliary fuel tanks are purged at the gate with nitrogen-enriched air (NEA) from an airport supply. Airplanes are equipped with a dedicated NEA service panel and manifold connected to a series of outlets inside the appropriate tank(s), thereby inerting the ullage (air space above the liquid fuel). Large transports take 30 minutes to inert, medium transports 25 minutes, and small transports 20 minutes.

Advantages

Simple, reliable, lightweight onboard equipment (tubes, etc.). Standard approach: every airplane supplied with NEA 1.7 times the maximum ullage volume. Service technician identifies airplane model and injects prescribed NEA volume.

Disadvantages

Dependent on dedicated airport supply system for NEA. Not inert after landing and until after ground servicing is completed. Ullage oxygen level increases during cruise, and—depending on initial fuel load—can exceed inert limits. Supply pressure varies by airplane type. Poses confined-space hazard to ground service personnel. New worldwide standard would be needed for interface and regulating equipment. Requires vent system changes for large portion of fleet.

Other issues

Dedicated, trained ground personnel needed. Impact on overall ground servicing operations (fuel, catering, baggage, cargo, etc.). Bigger impact will be on the airport infrastructure than on the airplane/airlines. Potential environmental issues from venting tanks overboard.

2. Onboard Ground Inerting (OBGI)

Concept

Same as 1 above except airplane uses onboard equipment to generate NEA. Only operates on the ground. Time to inert a large transport: 60 minutes.

Advantages

Airplane is self-sufficient. A better solution for flights into airports with no airport NEA supply.

Disadvantages

Takes longer after landing to reach inert levels and may impact airplane turn time. Provides limited protection during flight cycle depending on flight duration. System is heavy, bulky, and requires external dedicated electrical power supply. System and component reliability is poor. Confined space hazard to ground support personnel.

Other issues

Air inlet and exhaust for compressor and heat exchangers require airplane hull penetrations. Pipes must be shrouded (double-walled pipes where they enter the pressure hull to prevent filling the cabin with nitrogen gas in the event of a leak). Introduces new hazard exposure (very small) to crew and passengers. Insufficient space to retrofit aboard most current in-service and new production airplanes.

3. Onboard Inert Gas Generating Systems (OBIGGS)

Concept

Airplane uses onboard equipment to generate NEA. Operates throughout the flight, keeping the fuel tanks inert.

Advantages

Airplane is self-sufficient and thus not dependent on airports for NEA. Fuel tanks are actively inerted throughout ground and flight operations unless system is impacted by reliability.

Disadvantages

Demands more electrical power and high-pressure engine bleed air than is available on most airplanes. Weight and size aboard airplane much greater than for GBI. Draws exhausted cabin air as a source, increasing pressurization system maintenance burden. System and component reliability is poor. Introduces new hazard exposure to crew and passengers (very small).

Other issues

Shrouded pipes in the pressure hull. Mechanically very complex. Insufficient space available for installation aboard most in-service and current production airplanes.

4. Hybrid Systems

Concept

These are variations of 2 and 3 that have been simplified in an effort to reduce weight, volume, power demands, and air consumption. Two systems are under consideration:

- Hybrid OBGI system.
- Hybrid OBIGGS (a scaled-down version of the full system).

Advantages

Smaller, lighter, less expensive than OBGI and OBIGGS.

Disadvantages

More time required to inert the fuel tanks; complex; limited system and component reliability; weight and space requirements for retrofit.

Figure 1-1. Technical Summary of Inerting System Concepts

1.7 TECHNICAL LIMITATIONS

The FTIHWG concluded that several major technical limitations and airport infrastructure obstacles must be overcome before a practical fuel tank inerting system could be implemented.

1. The technical limitations/airport infrastructure obstacles for GBI for in-service, in production, and new type design (i.e., future) airplanes are
   - Development and construction of fixed inerting equipment for large airports and medium-sized airports.
   - Development and production of mobile inerting vehicles.
   - Development of a worldwide industry standard for the nozzle, interface panel configuration, and control system that connects the airplane and inerting equipment to deliver the appropriate amount of nitrogen to the airplane fuel tank.
2. The technical limitations for OBGI and OBIGGS inerting systems on in-service and in-production airplanes are that they
   - Demand more engine/airplane bleed air to operate than is available.
   - May demand more airplane electrical power to operate than is available.
   - Take up more space (volume) than might be available on most airplane types (a problem that increases as airplane size decreases); appropriate locations may not exist.
   - Have components that demonstrate low reliability and high failure rates at current technology levels.
3. Future airplane types can be designed with adequate bleed air, electrical power, and volume for OBGI and OBIGGS systems, so the technical limitation of these inerting systems on future airplane types will be
   - The low-reliability/high failure rate of their current-technology components unless mitigated by the application of future technological breakthroughs.

1.8 BENEFITS

The benefit of a safety enhancement system like inerting is avoided accidents resulting in lives saved and prevention of airplane and property destruction. Analyses performed by the FTIHWG established the estimated levels of this potential benefit that fleetwide inerting would achieve.

For this study, six commercial airplane categories were defined and generic models were created with fuel system characteristics as closely representative as possible of today's in-service fleet and current production models. Figure 1-2 summarizes the fleetwide flammability exposure of these generic-study-category airplanes.

	Large transport, 275 passengers	Medium transport, 195 passengers	Small transport, 117 passengers	Regional turbofan, 44 passengers	Regional turboprop, 31 passengers	Business jet, 7 passengers
B[illegible]						
Unheated CWTs (no adjacent heat sources)	6.8	No unheated CWT	5.1	2.6	No CWT	No CWT
Heated CWT (with adjacent heat sources)	36.2	23.5	30.6	No HCWT	No HCWT	No HCWT
Main wing tanks	3.6	2.4	3.6	1.6	0.7	1.6
Fuel tank flammability—with all operable inerting systems [illegible]						
Ground-based inerting (heated CWTs)	4.9	2.0	5.2	No HCWT	No HCWT	No HCWT
Onboard ground inerting (heated CWTs)	7.0	1.4	5.8	No HCWT	No HCWT	No HCWT
Hybrid OBIGGS (heated CWTs)	0.9	0.6	0.3	No HCWT	No HCWT	No HCWT
OBIGGS (all tanks)	~0	~0	~0	NA	NA	NA

*Due to the estimated low reliability of these onboard systems, the fleet exposure when including inoperative systems would be 2% to 3% higher.

Figure 1-2. Flammability Exposure—Generic In-Service and Current Production Airplanes

Fleetwide flammability exposure is a measure of the percentage of the airplane operating hours during which the fuel tank analysis indicates a flammable fuel/air mixture would exist. A Monte Carlo–type simulation was used to estimate these percentages. The figure includes the estimated flammability exposure levels for current unmodified (baseline) and modified flammability percentages.

In estimating accidents avoided, the passenger counts for each of these six generic airplanes were derived based on the average number of passenger and crew seats for actual airplane type in that study category. This value was then factored by load factors (percentage of passenger seats expected to be filled) taken from the *FAA Aviation Forecasts Fiscal Years 2001-2012*.

Figure 1-3 shows the accidents anticipated to be avoided through implementation of each of the three basic inerting system design concepts. Avoided accidents are a function of the flammability exposure values and the number of hours flown by all airplanes in each of the generic airplane categories over the evaluation period. For the purpose of the cost-benefit study described below, a 16-year evaluation period was used. Although a 10-year evaluation period had been used in the 1998 ARAC study and the FAA ground-based inerting study, a 16-year period was chosen for this study because of the significant time that is required to design and achieve full fleet incorporation of these inerting system design concepts.

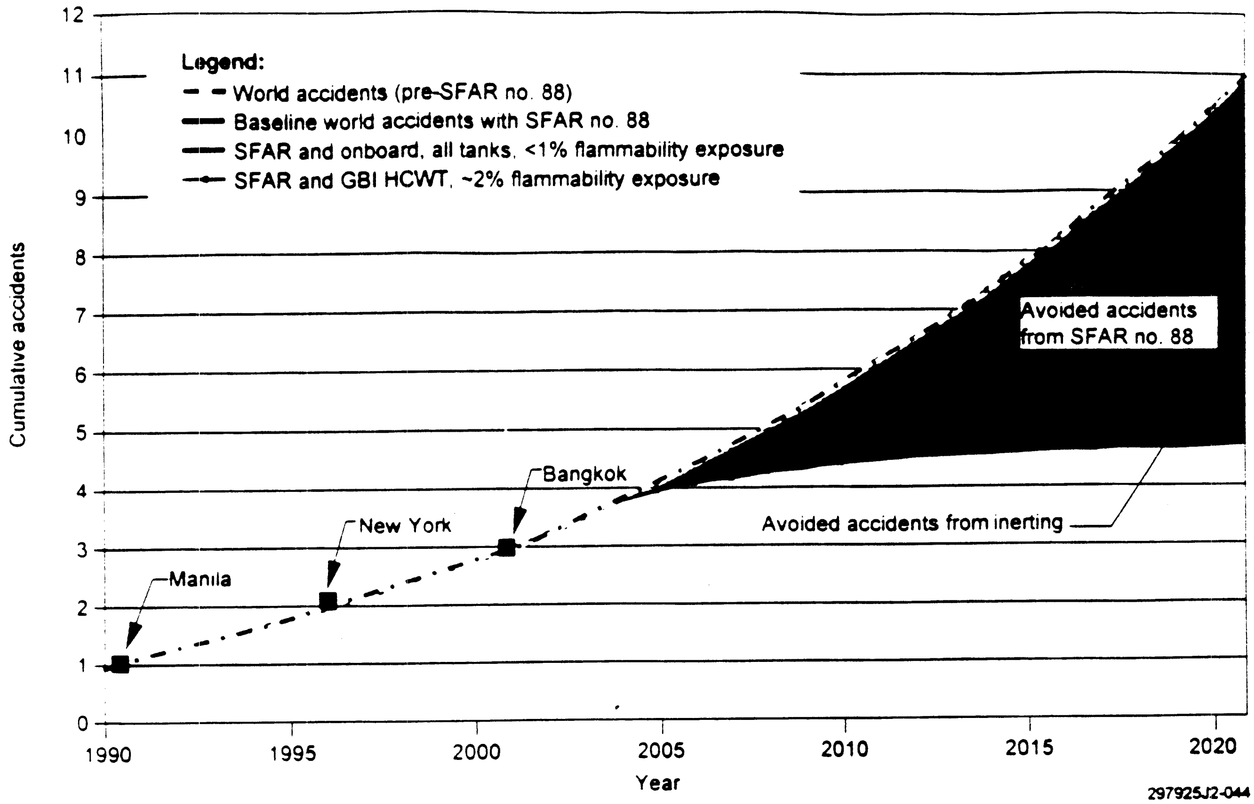


Figure 1-3. Worldwide Forecast Cumulative Accidents

The evaluation period begins in the first quarter of 2005 on the assumption that a rule change requiring fuel tank inerting would be effective at that time. Inerting systems for all applicable airplanes would be designed and certified by the first quarter of 2008 and all applicable airplanes would be modified by the first quarter of 2015. The evaluation period ends in the last quarter of 2020.

In figure 1-3 the avoided accidents analysis takes into account predicted reductions in accident rate of 75% attributable to SFAR no. 88. The 75% reduction had been estimated by the 1998 ARAC FTHWG. In addition, the Safety Team had reviewed the 1998 report and fuel tank safety enhancements as a result of recent AD actions and other improvements. Although consensus was not reached by the FTIHWG, the majority of the HWG considered that using the 75% predicted reduction in fuel tank explosions was reasonable.

The dotted line on figure 1-3 shows the estimated cumulative worldwide fuel tank explosion accident rate for a period 1990 through 2020. The three data points shown in the figure are actual accidents. The first two are confirmed to have resulted from fuel tank explosions while the third is suspected but has not yet been formally confirmed as such.

The estimated reduction in the accident rate resulting from SFAR no. 88 appears as a heavy black line. The third line down shows the further estimated improvement if a GBI system for inerting heated center wing tanks (CWT) were installed in the fleet. The fourth line down shows the estimated improvement if an OBIGGS system inerting all fuel tanks were adopted fleetwide. Thus, the estimated cumulative accident reductions attributable to GBI or OBIGGS are the difference between the SFAR line and those for GBI and OBIGGS.

The team evaluated accidents provided by the 1998 ARAC FTHWG study, plus the 2001 Bangkok accident, and agreed that the three most recent events (Manila 1990, New York 1996, and Bangkok 2001) should form the basis for statistically forecasting future events. These accidents each involved an explosion of the heated CWT, and the ignition source is unknown.

Figure 1-4 shows that the estimated number of avoided accidents with each inerting system design concept is approximately 1 accident (0.77 to 1.03) for the worldwide fleet in the 16-year evaluation period. Statistically, one fuel tank explosion in the 16-year evaluation period would result in approximately 1% of all fatalities from commercial airplane accidents forecast over that period. If these inerting system design concepts are fully implemented, after the implementation a ground-based system would likely prevent one fuel tank explosion in 10 years and an OBIGGS would likely prevent one fuel tank explosion in 8 years for the worldwide fleet.

	Large transport	Medium transport	Small transport	Regional turbofan	Regional turboprop	Business jet	Total
Ground-based inerting (HCWT only)	0.24	0.9	0.54	No HCWT	No HCWT	No HCWT	0.87
Onboard ground inerting (HCWT only)	0.20	0.9	0.48	No HCWT	No HCWT	No HCWT	0.77
Hybrid OBIGGS (HCWT only)	0.24	0.9	0.58	No HCWT	No HCWT	No HCWT	0.91
OBIGGS (all tanks)	0.28	0.12	0.63	NA	NA	NA	1.03

Figure 1-4. Estimated Cumulative Worldwide Avoided Accidents, 2005 Through 2020

The estimated number of avoided accidents for the U.S. fleet ("N" registered airplanes) would be approximately 46% of the projected accidents avoided worldwide. It is estimated that for the same time period a ground-based design system concept would likely prevent one fuel tank explosion in 19 years and the OBIGGS would likely prevent one accident in 16 years for the U.S. fleet.

Based on this analysis, an estimate could be made of the expected number of lives that might be saved through prevented fuel tank explosions and postcrash fires during the evaluation period from 2005 to 2020. Using the above process, it is estimated that once either a GBI or OBIGGS system is fully implemented in the fleet, the accumulated fractional number of prevented fatalities over the 16-year evaluation period would be 132 for GBI and 253 for OBIGGS from in-flight and ground fuel tank explosions and postcrash fires.

1.9 HAZARDS

Nitrogen is a colorless, odorless, nontoxic gas that is impossible for human senses to detect when excessive concentrations displace the oxygen normally present in the air. Depending on the degree of oxygen depletion, the effects of breathing nitrogen-enriched air (NEA) range from decreased ability to perform tasks to loss of consciousness and death. Fuel tank inerting procedures would include stringent measures to minimize these hazards. The risks would exist wherever gaseous or cryogenic nitrogen is handled in the global aviation infrastructure.

The FTIHWG lacks the expertise to assess these risks with confidence. However, a simple extrapolation of available data from the Occupational Safety and Health Administration (OSHA) and National Institute of Occupational Safety and Health (NIOSH) would suggest a rate of 1.4 to 4.7 fatalities per year worldwide. Based on assumed annual fleet growth rates and inerting system implementation assumptions, it is forecast that from 24 to 81 lives may be lost over the 2005–2020 study period as a result of this hazard.

1.10 COST-BENEFIT ANALYSIS

Figure 1-5 shows the present value estimate of inerting system total costs and monetary value of the benefits gained by introducing each of the three basic inerting design system concepts. The benefits were calculated by multiplying the annual number of avoided accidents (presented as fractional values) by the accident cost and then discounting these values by a net discount rate of 7% to the year 2005, which is the beginning of the evaluation period. The accident costs were estimated using established Department of Transportation (DOT) values. The benefits also include the monetary value of lives saved in postcrash fires. They do not include the cost of lives lost due to the hazards of inerting. The total cost for each inerting system includes the cost for in-service, current production, and new type design airplanes. There is little difference in cost between in-service and current production airplanes, except for the 20% to 30% higher installation costs for the retrofit airplanes and the associated airplane downtime. Also, with today's technology, there is little difference in the cost between current production and new type design airplanes.

	Benefits ($US billion)	Cost ($US billion)	Cost-benefit ratio
GBI (HCWT only)	0.245	10.37	42.3:1
OBGI (HCWT only)	0.219	11.60	52.9:1
Hybrid OBIGGS (HCWT only)	0.257	9.90	38.5:1
OBIGGS (all tanks)	0.441	20.78	47.1:1

Figure 1-5. Cost-Benefit Analysis Results, Worldwide Fleet, 2005 Through 2020, Based on Present Value in Year 2005 $US

The benefits shown in figure 1-5 have been calculated on the basis of a 75% reduction in projected fuel tank explosions due to SFAR no. 88. If the actual reduction in fuel tank explosions due to SFAR no. 88 proves to be less than 75%, then the benefits from inerting would be proportionally greater, and vice versa.

1.11 OVERALL CONCLUSION

The FTIHWG has concluded that the current technology of GBI, OBGI, and OBIGGS cannot meet the desired evaluation criteria for a fuel tank inerting system. This conclusion was reached collaboratively by many involved aviation and industry experts who, after intensive efforts, could not devise a practical, timely, and cost-effective method of proposing a fuel tank inerting design concept as a viable solution based on the Tasking Statement guidelines.

The FAA Tasking Statement for this ARAC FTIHWG study requested that this Working Group provide recommended regulatory text for new rulemaking based on the lowest flammability level that could be achieved by an inerting system design concept that would meet the FAA regulatory evaluation requirements. These evaluation requirements include a cost-benefit analysis similar to the analysis performed in this study. Because this study was unable to identify any practical way of implementing the inerting design concepts studied, the FTIHWG concluded that they could not recommend regulatory text based on the flammability level of an inerting system.

The FTIHWG also concluded that if a GBI system is considered for implementation, it will be necessary, before promulgating an airplane requirement, to resolve the current lack of global regulatory authority and industry control over the introduction and construction of new airport inerting supply systems, fixed or mobile.

Consequently, this FTIHWG has also concluded that the FAA, NASA, and the industry must continue to work cooperatively to research methods to reduce fuel tank flammability exposure that can be introduced much sooner than any of the inerting concepts. They should also pursue further basic research into technical breakthroughs in fuel tank inerting system design concepts as well as alternative concepts to improve the fuel tank safety of existing and future airplane designs.

1.12 RECOMMENDATIONS

The ARAC FTIHWG specifically recommends the following actions to be expeditiously carried out by the FAA, NASA, and the industry:

Inerting Systems

- Continue to evaluate and, where appropriate, investigate means to achieve a practical onboard fuel tank inerting system design concept for future new type design airplanes.
- Pursue technological advancements that would result in onboard fuel tank inerting designs having decreased complexity, size, weight, and electrical power requirements, and increased efficiency, reliability, and maintainability.
- Perform NEA membrane research to improve the efficiency and performance of membranes resulting in lower non-recurring costs of NEA membrane air-separation systems. For example, basic polymer research to increase the operational temperature of membranes to a level above 302°F.
- Conduct basic research into high-efficiency, vacuum-jacketed heat exchangers, and lighter, more efficient cryogenic refrigerators for use in inerting systems.
- If a practical means of achieving a cost-beneficial fuel tank inerting system is found, establish a corresponding minimum flammability level and reevaluate and propose regulatory texts and guidance materials accordingly.

Fuel Tank Flammability

- Evaluate means to reduce fuel tank flammability based on existing (e.g., directed ventilation, insulation) or new technology that might be introduced sooner into the in-service fleet and current airplane production.
- Initiate a project to improve and substantiate current flammability and ignitability analyses to better predict when airplane fuel tank ullage mixtures are flammable. This research is needed to support informed design decisions and rulemaking.
- Initiate a project to thoroughly document and substantiate the flammability model used in this study.

ARAC
Fuel Tank Inerting
Harmonization Working Group

Executive Committee Briefing
Final Report Summary
August 8, 2001

Bradford Moravec, Co-chairman
Sean O'Callaghan, Co-chairman

Introduction

- Our task was to evaluate proposals for reducing the flammability of fuel tanks through use of inert gas. We have done so, and our conclusion is that fuel tank inerting will take many years to implement and will have an enormous operational impact, with costs that far exceed the benefits.
- However, we strongly recommend ongoing industry and governments research of inerting concepts. With technological breakthroughs, inerting may become more practical at some future date.
- We also strongly recommend pursuit of alternative flammability reduction methods such as directed ventilation, insulation, improved scavenging, and use of ground carts for air conditioning.
- Together with the actions already being taken in response to the recent SFAR on fuel tank design and maintenance, these alternative methods of flammability reduction will greatly reduce the risk of further fuel tank explosions.

Agenda

- Background
- Tasking Statement
- Working Group Formation
- Milestones
- Report Summary
- Sensitivity Analysis
- Conclusions
- Recommendations

Background

- FAA initiated rulemaking activity to re-evaluate the industry's approach to fuel tank safety following the 1996 fuel tank explosion on a 747 airplane.
- In 1998, the FAA tasked ARAC with a six month project to provide specific recommendations and propose regulatory text for rulemaking that would significantly reduce or eliminate the hazards associated with explosive fuel vapors on transport category airplanes.
- In July 1998, ARAC Fuel Tank Harmonization Working Group recommend that the FAA further investigate the possibility of directed ventilation and ground based inerting of fuel tanks.
- The 2001 Working Group's report is an extension of the 1998 Fuel Tank Harmonization Working Group's efforts.

Tasking Statement

- The ARAC tasking statement was published in July of 2000.
- The tasking statement gave 12 months to draft a report that would provide data needed for the FAA to evaluate the feasibility of implementing regulations that would require eliminating or significantly reducing the development of flammable vapors in fuel tanks.
- The tasking statement specified that the report should evaluate the feasibility of three specific inerting system concepts and any other inerting concept determined by the Working Group or its individual members, to merit consideration.

Tasking Statement

Inerting system concepts studied by the Fuel Tank Inerting Harmonization Working Group (FTIHWG):

- Ground-Based Inerting (GBI)
- Onboard Ground-Inerting (OBGI)
- Onboard Inert Gas Generating System (OBIGGS)
- Derivative combinations of OBGI and OBIGGS. They are described as "hybrid systems" in this report.

Tasking Statement

Tasking Statement Guidelines

- Consider reliable designs with little or no redundancy to minimize the cost of the design method together with a recommendation for dispatch relief using the master minimum equipment list (MMEL).
- Develop regulatory text based on the lowest flammability level that could be achieved by an inerting system design that would meet FAA's regulatory evaluation requirements.
- Evaluate options for implementing these new regulations.
- Identify technical limitations for design options considered impractical.
- Provide guidance material on analyses and testing for demonstrating certification compliance and instructions for continued airworthiness.

Working Group Formation

- U.S. and European co-chairman proposed by AIA and AEA respectively and confirmed by ARAC EX-COM.
- FAA Tasking Statement of July 10, 2000 requested experts interested in participating in the Working Group notify them no later than August 11, 2000.
- FAA received numerous replies from which the working group members were selected. The working group members represented a wide variety of organizations.
- The Working Group held their first meeting September 25 - 26, 2000.
- Task team members were requested from various groups and organizations to provide special expertise, resulting in over 70 task team members from U.S. and Europe.

Fuel Tank Inerting Harmonization Working Group Organization

Working Group
Co-Chairs, AIA, ATA, AECMA, ALPA, AEA, IAM, FAA, JAA, NADA/F, Industrial Gas Co, API

Co-chair Brad Moravec
Co-chair Sean O'Callaghan

Integration
- Airplane Level Integration
- Ad Min & Tech Writing
- Project Scheduling

Grd Based Design
- Design, Installation, Operation & Maintenance Requirements
- Concept Development
- Feasibility & Cost/Benefits
- Secondary Effects

O/B Design
- Design, Installation, Operation & Maintenance Requirements
- Concept Development
- Feasibility & Cost/Benefits
- Secondary Effects

Airport Facility
- Design, Installation, Opts & Maint Requirements
- Concept Development
- Feasibility & Cost/Benefits
- Environmental Impact

Airplane Ops & Maintenance
Impact of designs on fleet performance, operation, maintenance, dispatch reliability, MMEL, etc

08/03/01

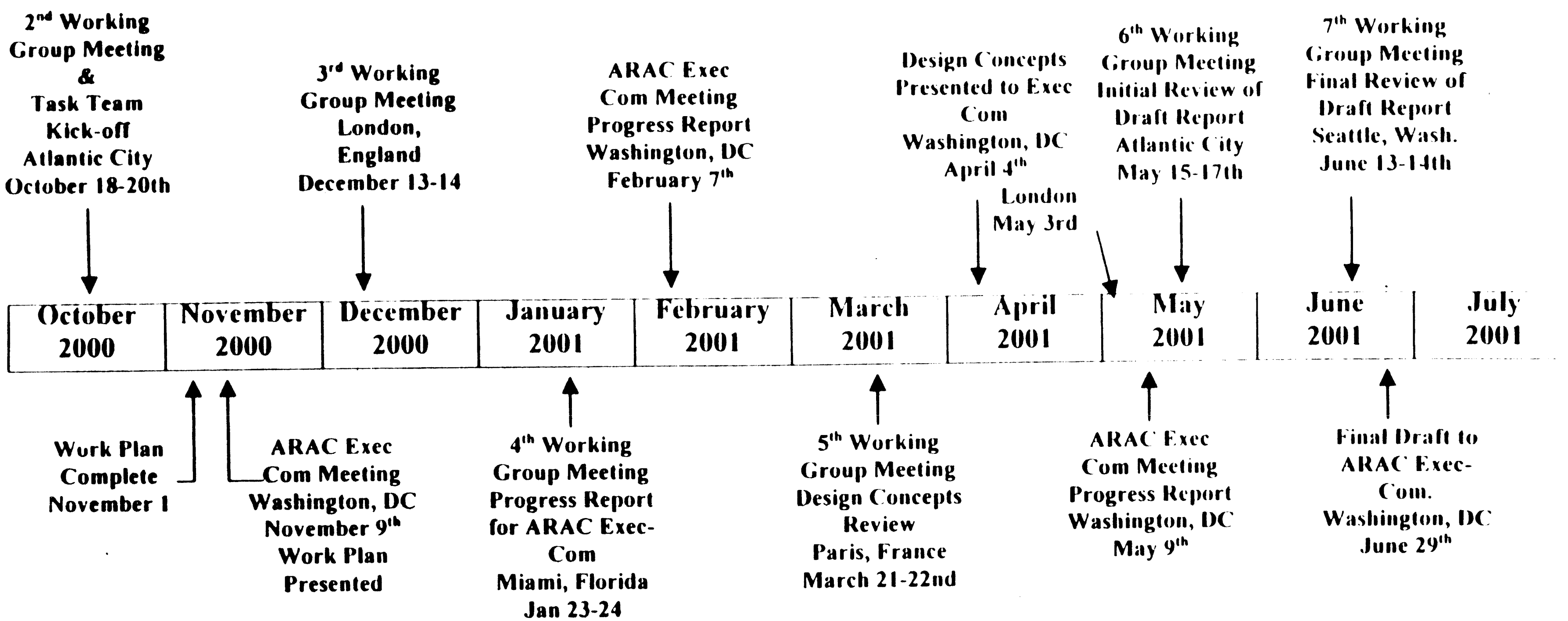
Estimating and Forecasting
- Economic model and trade study support
- Fleet Forecast
- Cost reduction proposals

Page 1

Safety Analysis
- Safety Analysis
- Failure Modes and Effects
- Fleet history

Rulemaking
- Regulatory Text
- Certification Guidance

ARAC Fuel Tank Inerting Harmonization Working Group
Major Milestones



Fuel Tank Inerting Harmonization Working Group

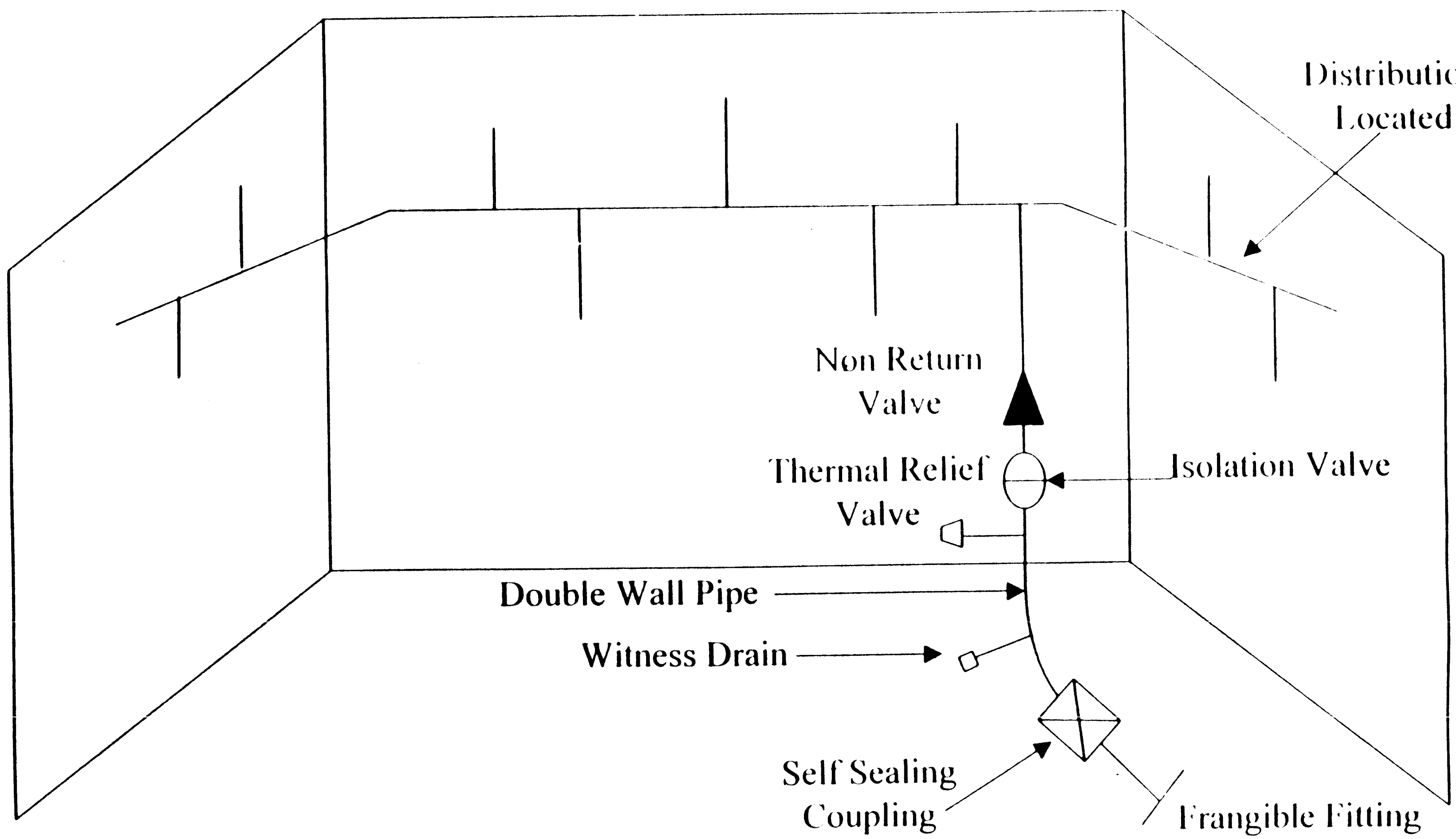
Report Summary

Ground-Based Inerting (GBI)

- **Concept**
  - Center wing tanks (heated or unheated) and auxiliary fuel tanks are purged at the gate with nitrogen-enriched air (NEA) from an airport supply.
  - Airplanes are equipped with a dedicated NEA service panel and manifold connected to a series of outlets inside the appropriate tank(s), thereby inerting the ullage (air space above the liquid fuel).
  - Standard approach: every airplane supplied with NEA 1.7 times the maximum ullage volume. Service technician identifies airplane model and injects prescribed NEA volume.
  - Large transports take 30 minutes or less to inert, medium transports 25 minutes, and small transports 20 minutes.

Report Summary

GBI Center Tank Concept



Report Summary

Ground-Based Inerting (GBI)

- **Advantages**
  - Simple, reliable, lightweight onboard equipment (tubes, etc.).
  - Concept was recently demonstrated in a flight test program on a commercial airplane.

- **Disadvantages**
  - Dependent on dedicated airport supply system for NEA.
  - Ullage oxygen level increases during flight, and—depending on initial fuel load—can exceed inert limits.
  - Not inert on approach and landing.
  - NEA supply pressure varies by airplane type.
  - Confined-space hazard to ground service personnel (very small).
  - Requires vent system changes for large portion of fleet.

Report Summary

Ground-Based Inerting (GBI)

- **Technical limitations and other issues**
  - Dedicated, trained ground personnel needed. Impact on overall ground servicing operations (fuel, catering, baggage, cargo, etc.).
  - Potential environmental issues from venting tanks overboard.
  - Development and construction of fixed inerting equipment for large airports and medium-sized airports throughout the world.
  - Development and production of mobile inerting vehicles.
  - Development of a worldwide standard for the nozzle, interface panel configuration, and control system that connects the airplane and inerting equipment to deliver the appropriate amount of nitrogen to the airplane fuel tank.

Report Summary

Onboard Ground Inerting (OBGI)

- **Concept**

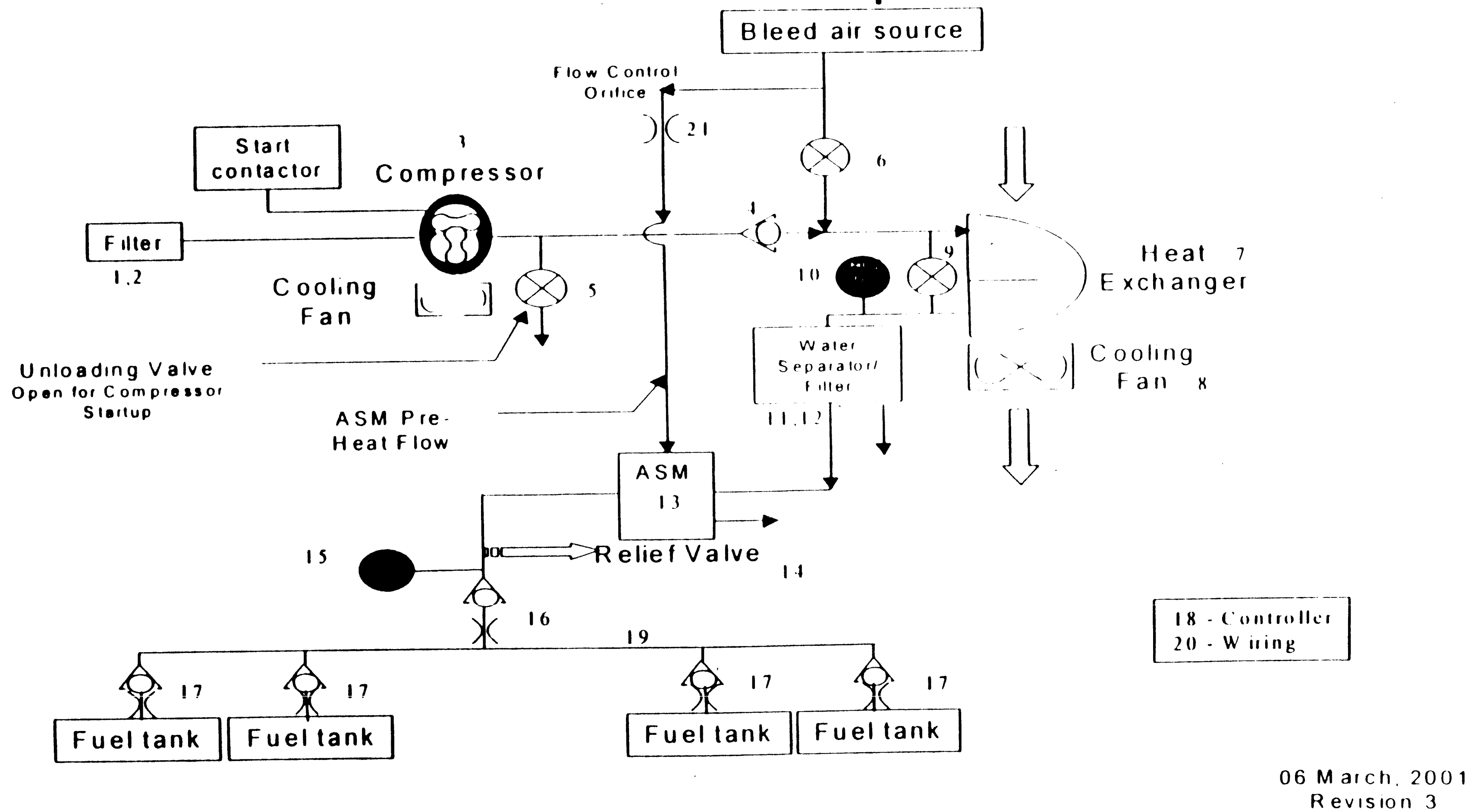
  Same as GBI except airplane uses onboard equipment to generate NEA. Only operates on the ground. Time to inert a large transport: 60 minutes.

- **Advantages**
  - Airplane is self-sufficient except for an external electrical power supply.

- **Disadvantages**
  - Takes longer than GBI to reach inert levels and may impact airplane turn time (design criteria assumes no increase in turn-time).
  - Provides limited protection during flight cycle.
  - System is heavy and bulky compared to GBI.
  - Requires external dedicated electrical power supply.
  - System and component reliability is poor.
  - Air inlet and exhaust for compressor and heat exchangers require airplane hull penetrations.

Report Summary

OBGIS Concept



Report Summary

Onboard Ground Inerting (OBGI)

- **Technical limitations and other issues**
  - Introduces new hazard exposure (very small) to crew and passengers.
  - Insufficient space (volume) on most in-service and production airplane types (a problem that increases as airplane size decreases).
  - Adequate locations on the airplane may not exist.
  - Low reliability and high failure rates of components.

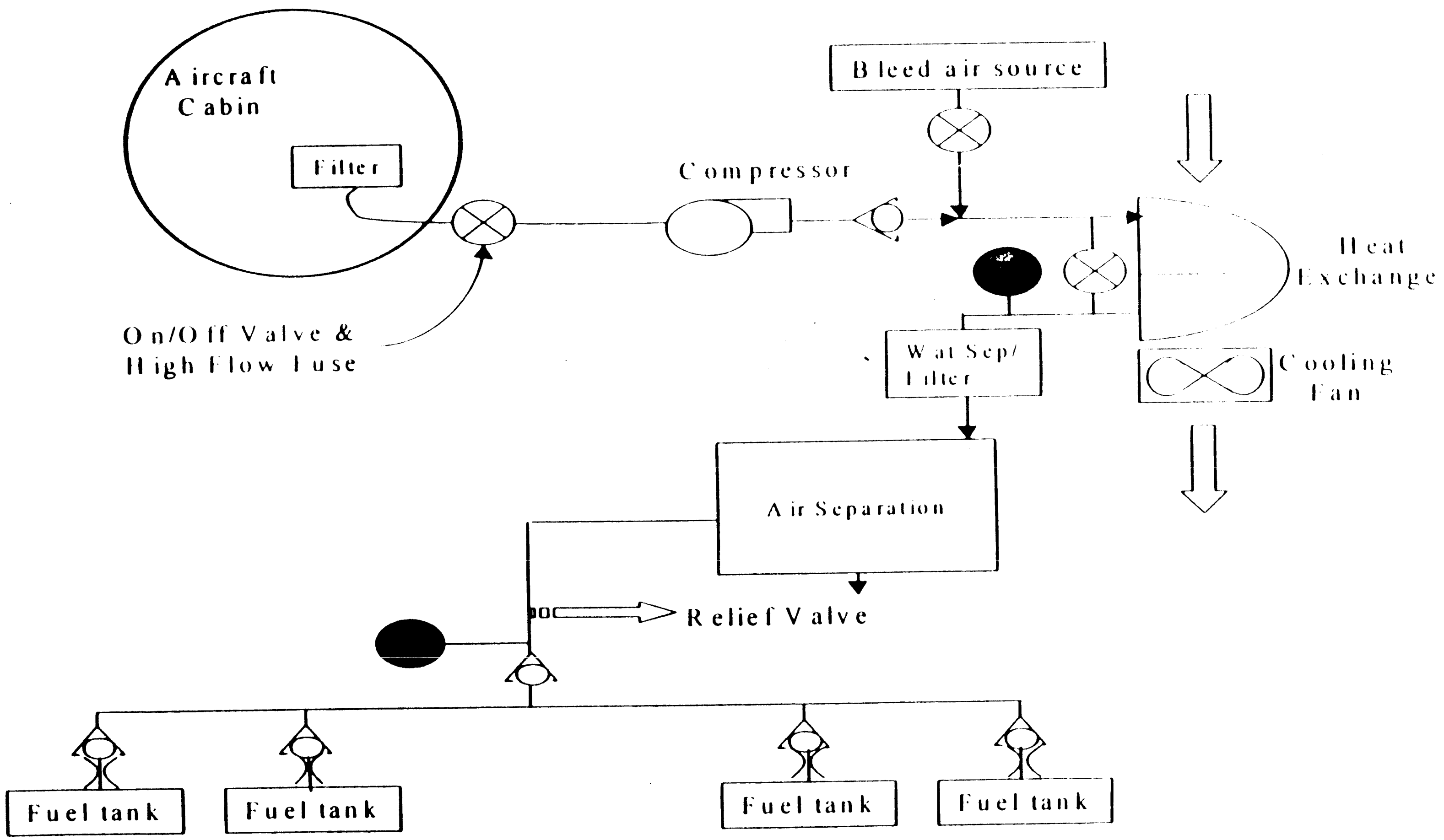
Report Summary

Onboard Inert Gas Generating Systems (OBIGGS)

- **Concept**
  - Airplane uses onboard equipment to generate NEA.
  - Operates throughout the flight to keep the fuel tanks inert.
- **Advantages**
  - Airplane is completely self-sufficient.
  - Fuel tanks are actively inerted throughout ground and flight operations.
- **Disadvantages**
  - Weight and size aboard airplane much greater than for GBI.
  - Draws exhausted cabin air as a source, increasing pressurization system maintenance burden.
  - Mechanically very complex, system and component reliability is poor.

Report Summary

- Generic OBIGGS Concept



Report Summary

Onboard Inert Gas Generating Systems (OBIGGS)

- **Technical Limitations and other issues**
  - Demands more electrical power and high-pressure engine bleed air than is available on most in-service and production airplanes.
  - Insufficient space available for installation aboard most in-service and current production airplanes (a problem that increases as airplane size decreases).
  - Adequate locations on the airplane may not exist.
  - Low reliability and high failure rates of components.
  - Introduces new hazard exposure to crew and passengers (very small).
  - Future airplane types can be designed with adequate bleed air, electrical power, and volume but a technology breakthrough is required to significantly improve the system reliability and weight.

Report Summary

Hybrid Systems

- **Concept**
  - These are variations of OBGI and OBIGGS that have been simplified in an effort to reduce weight, volume, power demands, and air consumption.

- **Advantages**
  - Smaller, lighter and less expensive than OBGI or OBIGGS

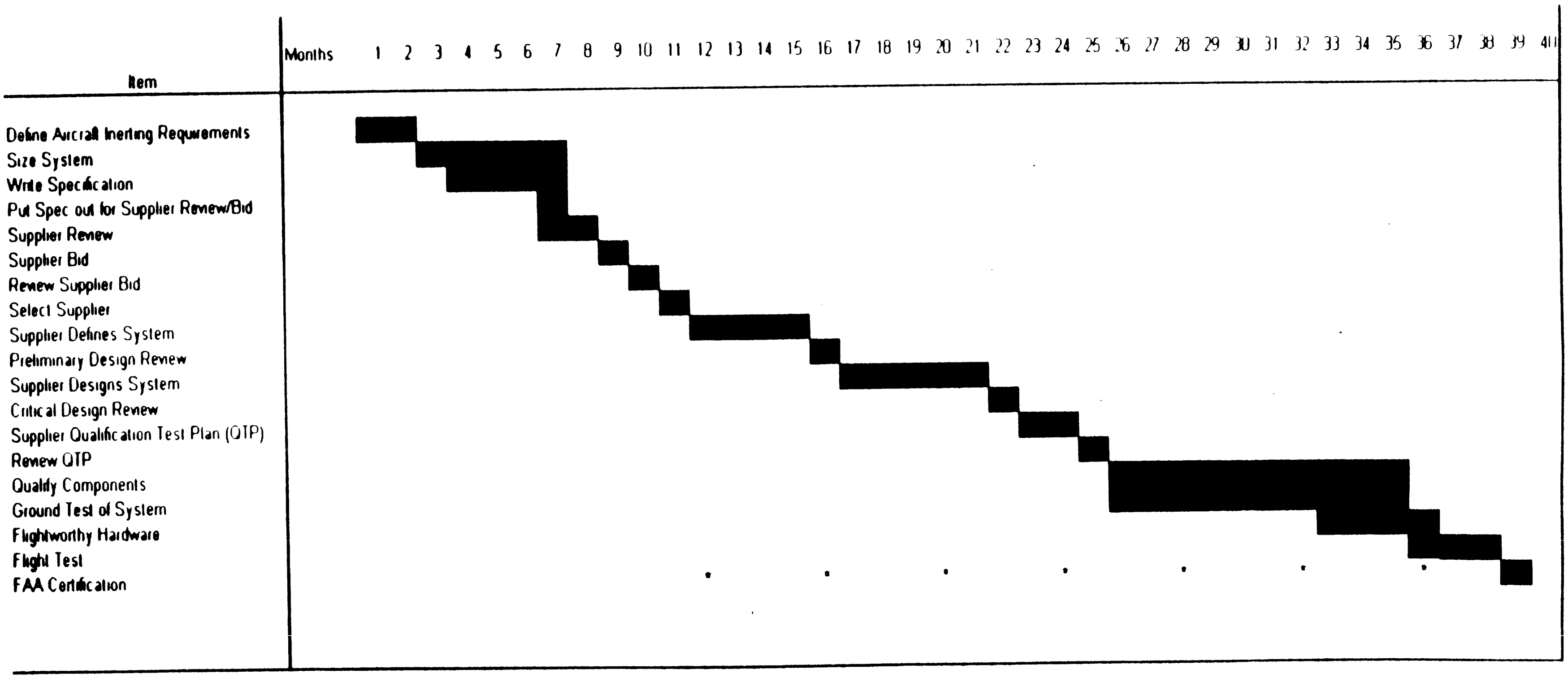
Report Summary

- **Disadvantages**
  - More time required to inert the fuel tanks
  - Fuel tanks are not always inert
  - System and component reliability is poor
  - Introduces new hazard exposure to crew and passengers (very small)
  - Unknown if sufficient space available for installation aboard most in-service and current production airplanes

- **Technical limitations**
  - Similar limitations as OBGI and OBIGGS but to a smaller degree

Report Summary

Estimated development schedule for an on-board inerting system



* = FAA Involvement (design review, component qualification, regulatory issues, flight worthiness, etc)

Report Summary

Fleet-wide flammability exposure

Fleet-wide flammability exposure is an estimate of the percentage of the airplane operating hours in which a flammable fuel/air mixture would exist. Six generic airplane categories were evaluated.

	Large Transport 275 pax	Medium Transport 195 pax	Small Transport 117 pax	Regional Turbofan 44 pax	Regional Turboprop 31 pax	Biz Jet 7 pax
Baseline fuel tank flammability—no inerting system, Percent exposure						
Unheated CWTs	6.8	N/A	5.1	2.6	N/A	N/A
Heated CWT	36.2	23.5	30.6	N/A	N/A	N/A
Main wing tanks	3.6	2.4	3.6	1.6	0.7	1.6
Fuel tank flammability with inerting system, Percent exposure						
GBI Heated CWTs	4.9	2.0	5.2	N/A	N/A	N/A
OBGI Heated CWT*	7.0	1.4	5.8	N/A	N/A	N/A
Hybrid OBIGGS HCWT*	0.9	0.6	0.3	N/A	N/A	N/A
OBIGGS All tanks*	~0	~0	~0	N/A	N/A	N/A

*Due to the estimated low reliability of these onboard systems, the fleet exposure would be 2% to 3% higher when accounting for the time the systems would be inoperative.

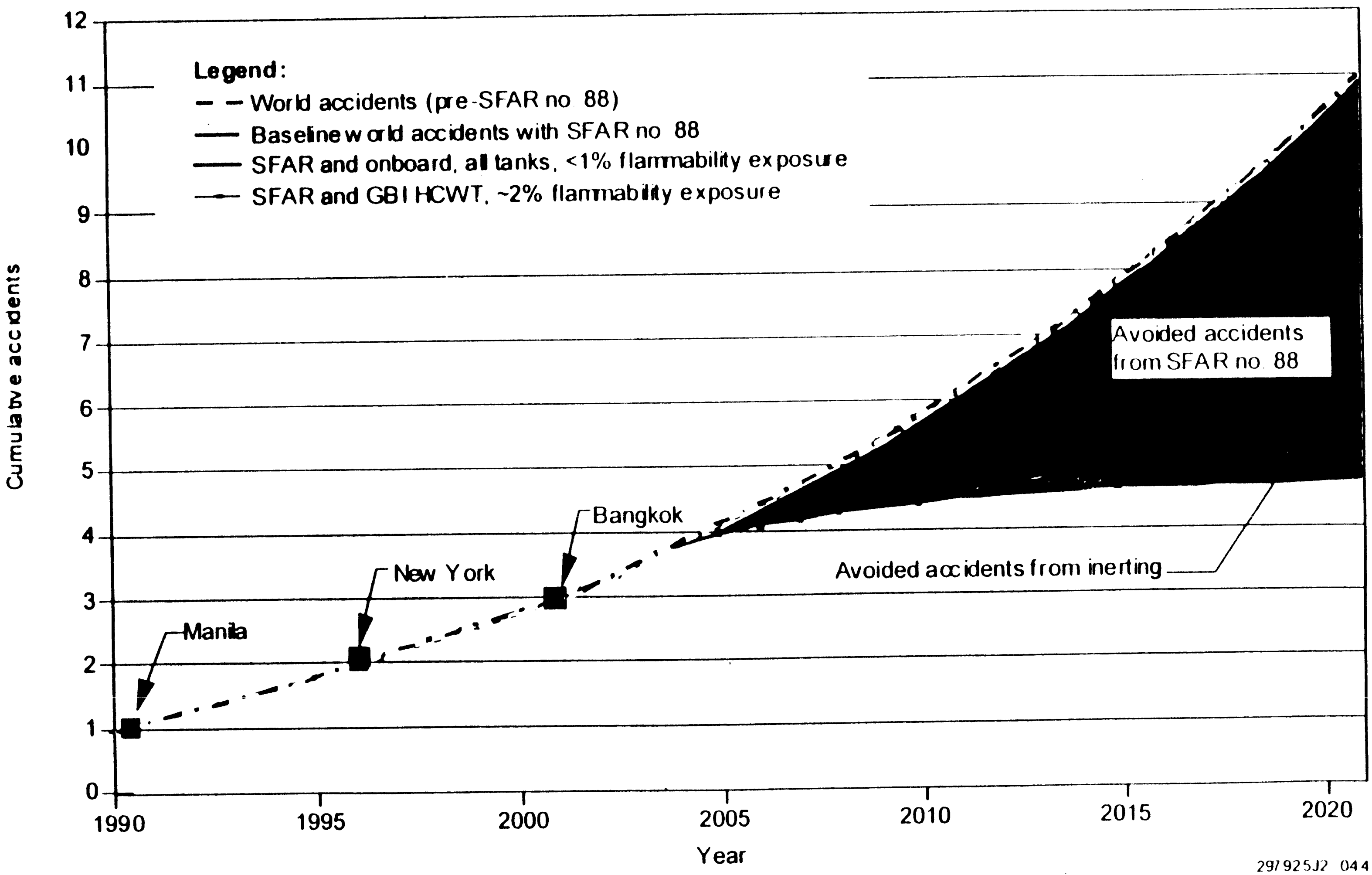
Report Summary

Avoided Accidents with Inerting

- Avoided accidents are a function of
  - Current accident rate
  - Fleet flammability exposure of the inerting system
  - Fleet operating hours
  - Expected benefit from SFAR 88 (Assumes 75% reduction in accident rate. Not all working group members agreed with this value. A working group consensus was reached on adding the following wording: If the actual reduction in fuel tank explosions due to SFAR 88 proves to be less than 75%, then the benefits from inerting would be proportionally greater, and vice versa)
- Total lives saved from avoided fuel tank accidents and post-crash fuel tank fires (initial cause unrelated to the fuel system) over the 16 year study period.
  - 132 for GBI
  - 253 for OBIGGS

Report Summary

Avoided Accidents based on 75% SFAR benefit



Fuel Tank Inerting Harmonization Working Group

Report Summary

Inerting Hazards

- Nitrogen is a colorless, odorless, nontoxic gas that is impossible for human senses to detect.
- The effects of breathing nitrogen-enriched air (NEA) range from decreased ability to perform tasks to loss of consciousness and death.
- Fuel tank inerting procedures would include stringent measures to minimize these hazards. Nevertheless, some small risk would exist wherever gaseous or cryogenic nitrogen is handled in the global aviation industry.
- Extrapolation of Occupational Safety and Health Administration (OSHA) and National Institute of Occupational Safety and Health (NIOSH) data indicates that from 24 to 81 airline employee lives (worldwide) may be lost over the 16 year study period as a result of inerting accidents.
- The FTIHWG lacked the expertise to confidently assess these risks and agreed not to include lives lost due to inerting accidents in the cost-benefit analysis. Additional research is recommended to better quantify the risk.

Report Summary

Cost-Benefit Analysis

- The cost-benefit analysis methods that were used are similar to the FAA's methods used in regulatory evaluations.
- The benefits include the monetary value of avoided accidents and lives saved in post-crash fires. Monetary values are based on FAA and Department of Transportation (DOT) data.
- The analysis includes an assumption of a 75% reduction in projected fuel tank explosions due to SFAR no. 88. If the actual reduction in fuel tank explosions due to SFAR no. 88 proves to be less than 75%, then the benefits from inerting would be proportionally greater, and vice versa.
- Costs and benefits were calculated for the 16 year study period from 2005 to the end of 2020. Present values were calculated by discounting the annual values at 7% to the year 2005.

Report Summary

Cost-Benefit Analysis

- The total cost for each inerting system includes the cost for modifying in-service, current production, and new type design airplanes.
- There is little difference in cost between in-service and current production airplanes, except for the higher installation costs for the retrofit airplanes.
- Also, with today's technology, there is little difference in the cost between current production and new type design airplanes.

Report Summary

Worldwide Implementation of an Inerting System
Present Value in 2005 $US

	Benefit $US billion	Cost $US billion	Cost-Benefit Ratio
GBI (HCWT only)	0.245	10.4	42:1
OBGI (HCWT only)	0.219	11.6	53:1
Hybrid OBIGGS (HCWT only)	0.257	9.9	39:1
OBIGGS (all tanks)	0.441	20.8	47:1

Sensitivity Analysis

After the final report was published the FAA's Working Group member sent a letter to the Co-Chairs questioning some of the assumption used in the study. To address his concerns, the working group conducted a brief sensitivity analysis to evaluate the effects of changing some assumptions.

- The sensitivity analysis evaluated the effects of :
  - SFAR 88 benefits
  - Labor hours and labor productivity
  - Number of airports with an inerting systems installed
  - Airplane operational data
  - Delay costs
  - Retrofit implementation
  - Ground vs in-flight accident rates
- None of these effects, or combinations of effects, were sufficient to change the working group's conclusions or recommendations.

Sensitivity Analysis

- Additional effects that were not considered in sensitivity analysis:
  - Selective ground based inerting (decreases costs)
  - Cancellation costs (increases cost)
  - Cost of gate turn-time increases (increases cost)
  - Cost of no MMEL relief (increases cost)
  - Airport equipment depreciation and replacement costs (increases cost)
  - Airline spare parts provisioning costs (increases cost)
  - Value of lives lost in inerting accidents (decreases benefits)

Sensitivity Analysis

Baseline assumptions for GBI

- Assume SFAR88 changes are fully implemented by 2007 and give a 75% reduction in accident rate (value from 1998 ARAC and the lower of the two values proposed in the SFAR NPRM)
- Assume the inerting process is accomplished by dedicated personnel. Large airplanes take 30 minutes, medium airplanes take 25 minutes and small airplanes take 20 minutes to inert. Assume 100% labor efficiency.
- Assume all B, C and D airports would get some form of an inerting system.
- Use the weight penalty developed in 1998 ARAC study. Accounts for weight and fuel volume limited take-offs.

Sensitivity Analysis

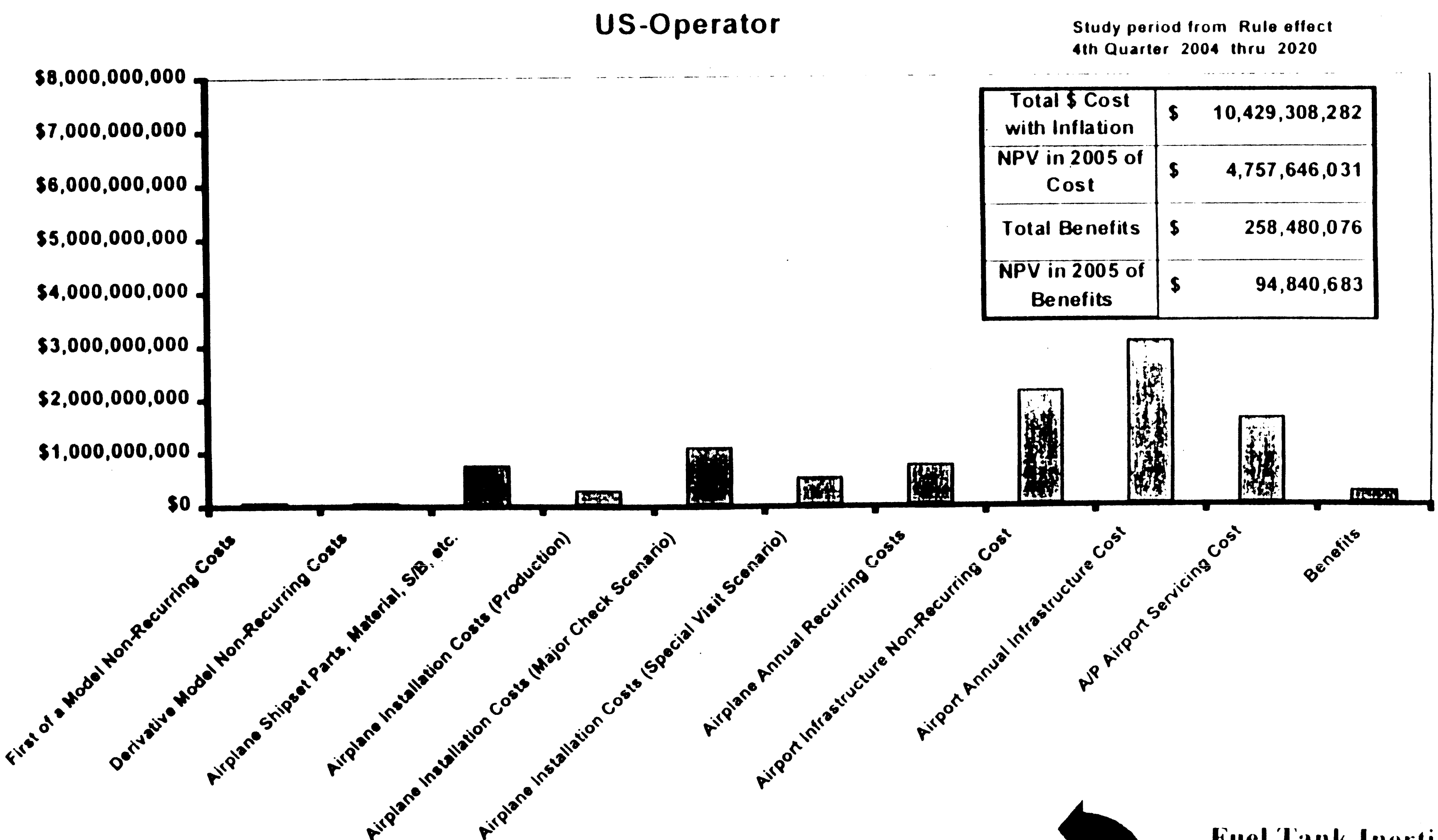
Baseline assumptions for GBI

- Assume the first 30 minutes of each delay is discounted.
- Assume 70% of retrofits are done during a heavy check.
- Assume that 15% of the future accidents occur on the ground (this is consistent with calculated flammability exposure time).
- Baseline cost-benefit ratio for US operators of 50:1

Baseline Cost Benefit
Ratio 50:1

Sensitivity Analysis

Scenario 11 - Ground Based Inerting HCWT only, All Transports



Total $ Cost with Inflation	$	10,429,308,282
NPV in 2005 of Cost	$	4,757,646,031
Total Benefits	$	258,480,076
NPV in 2005 of Benefits	$	94,840,683

Sensitivity Analysis

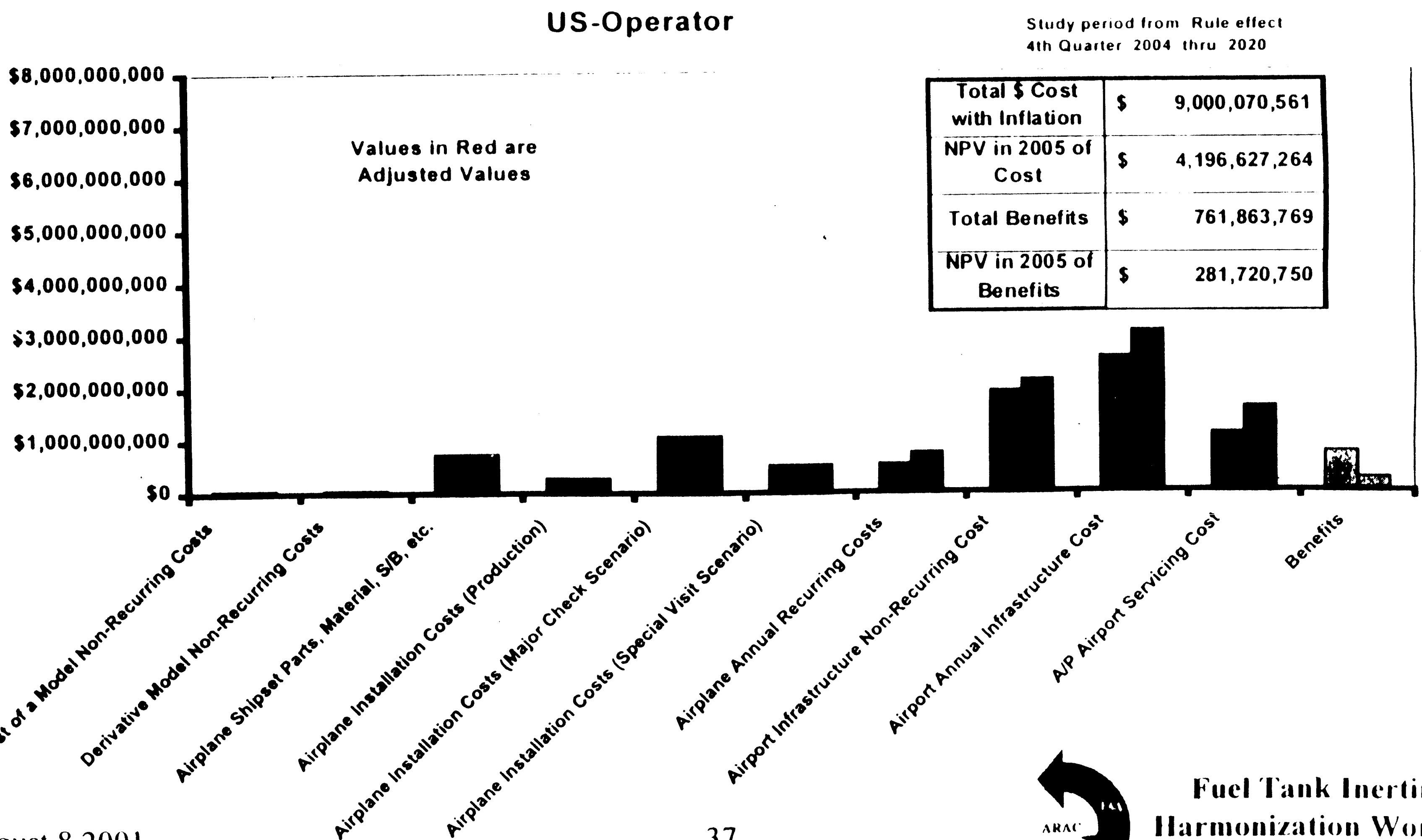
The next chart shows the effects making the following assumptions:

- Assume SFAR 88 changes are delayed until 2010 and are only 25 percent effective in reducing fuel tank accidents.
- Assume no dedicated inerting personnel. Assume 10 minutes per airplane to accomplish inerting at large and medium airports and $10 per airplane to accomplish inerting at small airports (Values proposed in FAA study)
- Assume inerting equipment is installed only at airports currently serviced by airplanes with 100 passengers or more (175 fewer airports).
- Assume no weight or fuel volume limited take-offs, significantly reduces the cost to carry additional weight of the inerting system.
- The combination of these assumptions lowers the cost-benefit ratio to 15:1

Cost Benefit Ratio
Decreased to 15:1

Sensitivity Analysis

Scenario 11 - Ground Based Inerting HCWT only, All Transports



Total $ Cost with Inflation	$	9,000,070,561
NPV in 2005 of Cost	$	4,196,627,264
Total Benefits	$	761,863,769
NPV in 2005 of Benefits	$	281,720,750

Sensitivity Analysis

The next chart shows the effects making the following assumptions:

- Assume SFAR changes are implemented by 2007 (baseline) and reduces the accident rate by 90% (high value used in SFAR NPRM)
- Assume baseline labor hours but productivity is reduced from 100% to 70%
- Assume Full delay costs per ATA study
- Assume 70% of the retrofits are accomplished outside of a heavy check
- Assume 1 in 3 accidents occurs on the ground (historical rate)
- These assumptions increase the cost-benefit ratio to 73:1

Cost Benefit Ratio
increased to 73:1

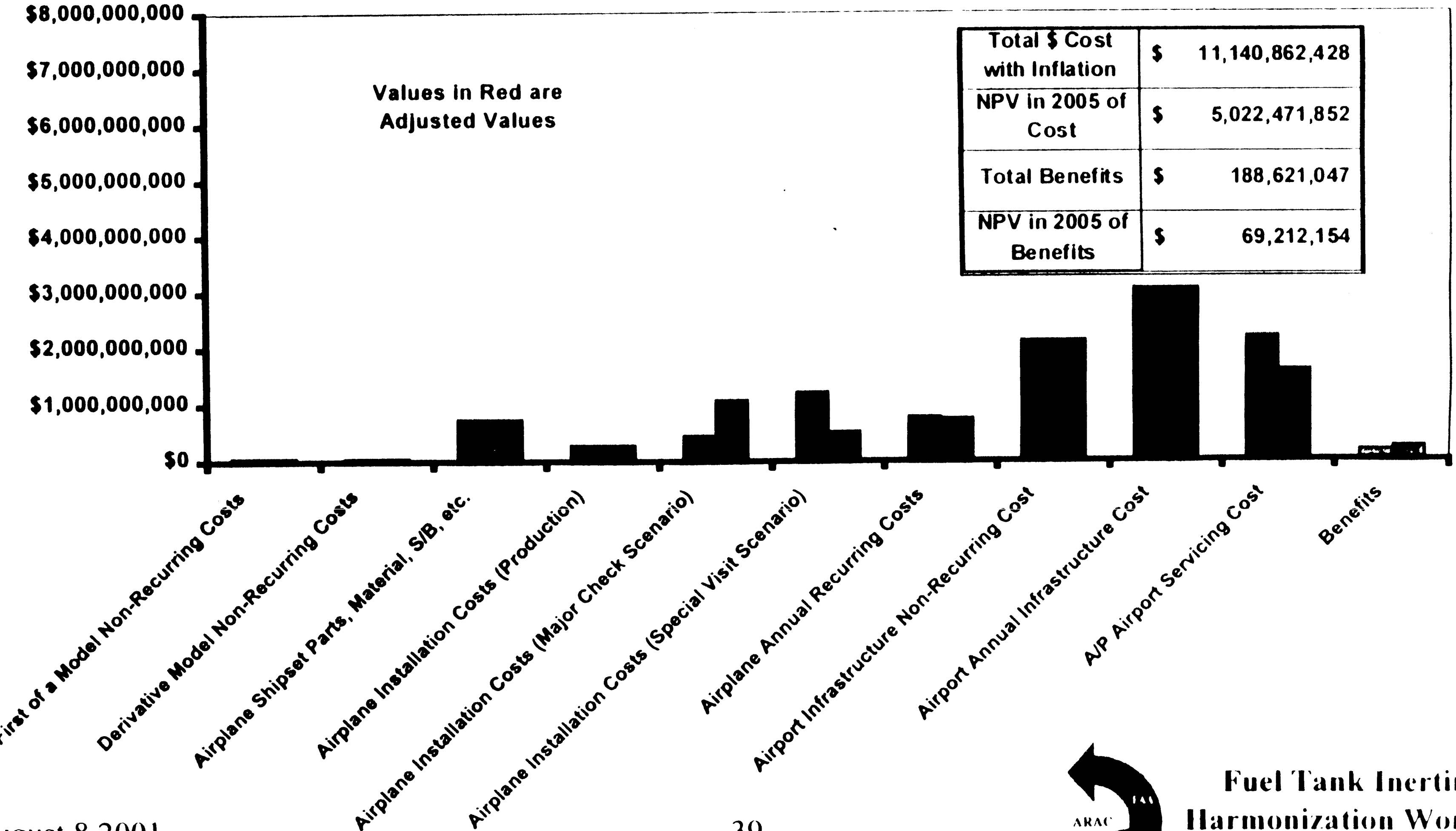
Sensitivity Analysis

Scenario 11 - Ground Based Inerting HCWT only, All Transports

US-Operator

Study period from Rule effect
4th Quarter 2004 thru 2020

Total $ Cost with Inflation	$	11,140,862,428
NPV in 2005 of Cost	$	5,022,471,852
Total Benefits	$	188,621,047
NPV in 2005 of Benefits	$	69,212,154



Sensitivity Analysis

Baseline assumptions for Hybrid OBIGGS

- Assume SFAR88 changes are fully implemented by 2007 and give a 75% reduction in accident rate (value from 1998 ARAC and the lower of the two values in the SFAR NPRM)
- Use the weight penalty developed in 1998 ARAC study. Accounts for weight and fuel volume limited take-offs
- Assume the first 30 minutes of each delay is [illegible]ounted
- Assume 70% of retrofits are done during a heavy check
- Assume that 15% of the future accidents occur on the ground (this is consistent with calculated flammability exposure time)
- Baseline cost-benefit ratio for US operators 41:1

Baseline Cost Benefit
Ratio 41:1

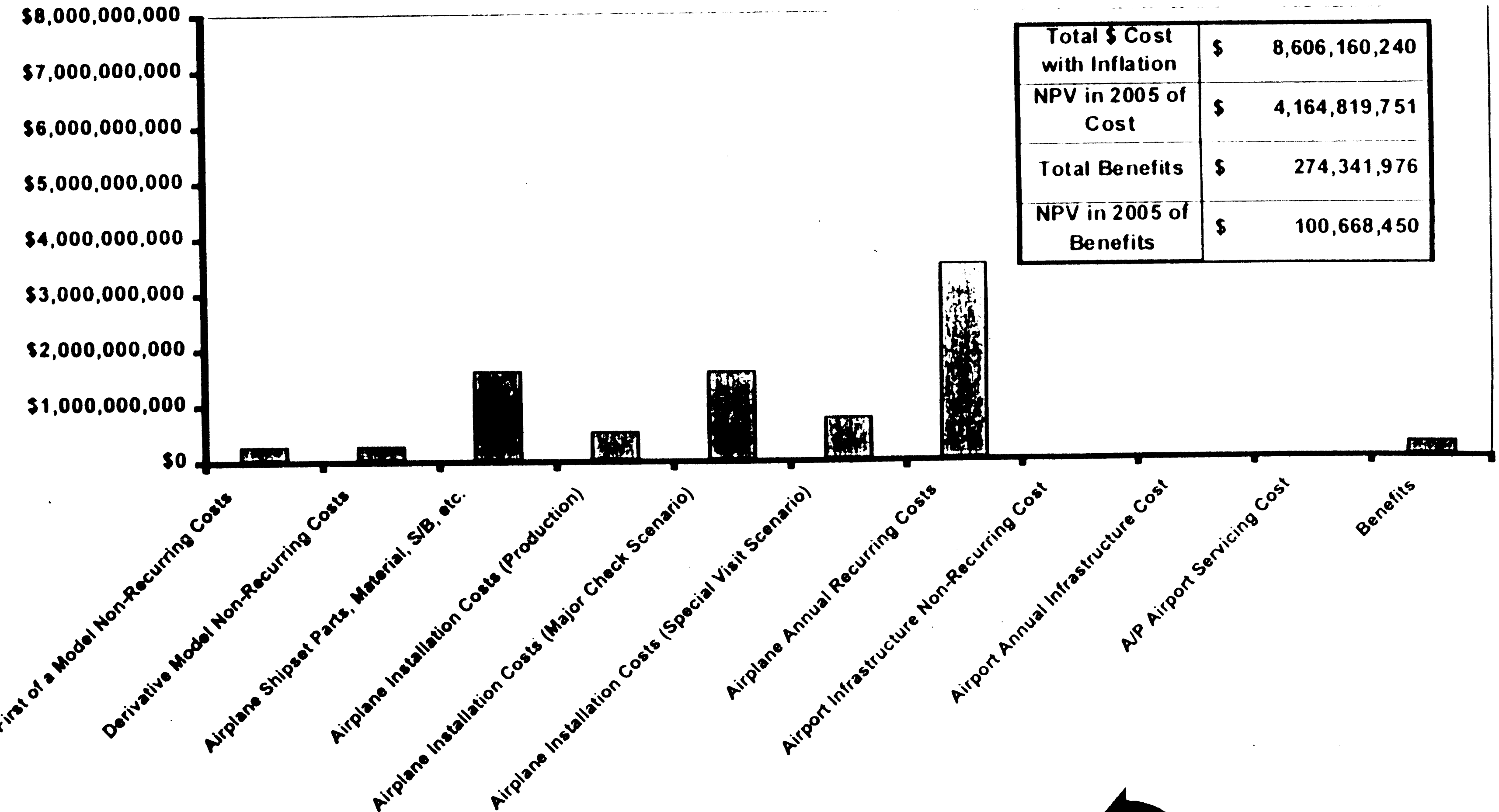
Sensitivity Analysis

Scenario 7 - Hybrid OBIGGS, HCWT only, Large and Medium Transports, Membrane Systems, & Small Transports, PSA/Membrane Systems

US-Operator

Study period from Rule effect 4th Quarter 2004 thru 2020

Total $ Cost with Inflation	$	8,606,160,240
NPV in 2005 of Cost	$	4,164,819,751
Total Benefits	$	274,341,976
NPV in 2005 of Benefits	$	100,668,450



Fuel Tank Inerting Harmonization Working Group

Sensitivity Analysis

The next chart shows the effects of the following assumptions:

- Assume benefits of full implementation of SFAR 88 delayed until 2010, and only 25 percent effective in reducing fuel tank accidents

- Assume no weight or fuel volume limited take-offs, significantly reduces the cost to carry additional weight of the inerting system

- The combination of these assumptions lowers the cost-benefit ratio to 12:1

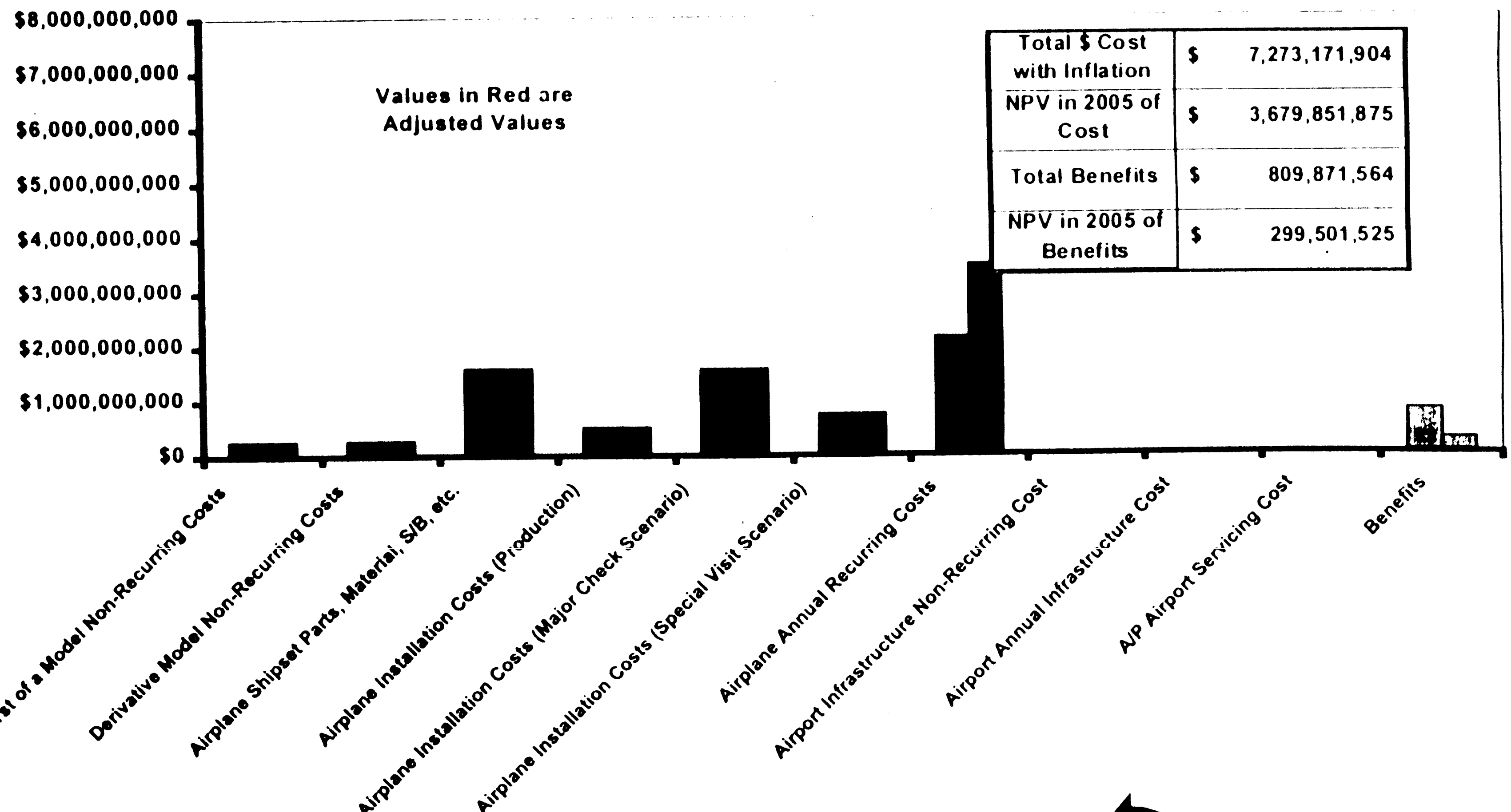
Cost Benefit Ratio decreased to 12:1

Sensitivity Analysis

Scenario 7 - Hybrid OBIGGS, HCWT only, Large and Medium Transports, Membrane Systems, & Small Transports, PSA/Membrane Systems

US-Operator

Study period from Rule effect 4th Quarter 2004 thru 2020



Total $ Cost with Inflation	$	7,273,171,904
NPV in 2005 of Cost	$	3,679,851,875
Total Benefits	$	809,871,564
NPV in 2005 of Benefits	$	299,501,525

Fuel Tank Inerting Harmonization Working Group

Sensitivity Analysis

The next chart shows the effects of the following assumptions:

- Assume SFAR changes are implemented by 2007 (baseline) and reduces the accident rate by 90% (high value used in SFAR NPRM)
- Assume full delay costs per ATA study
- Assume 70% of the retrofits are accomplished outside of a heavy check
- Assume 1 in 3 accidents occur on the ground (historical rate)
- These assumptions increase the cost-benefit ratio of 61:1

Cost Benefit Ratio increased to 61:1

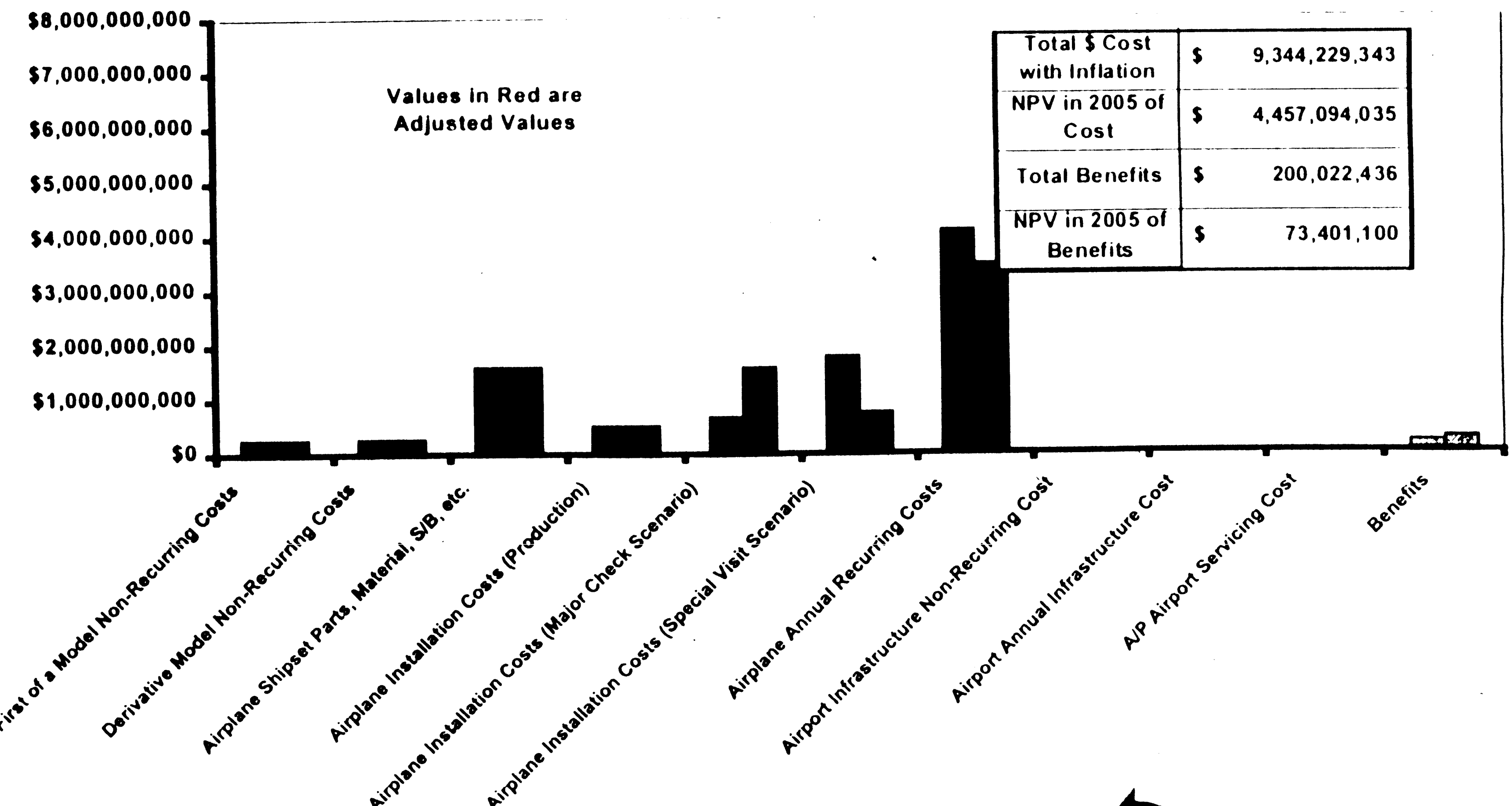
Sensitivity Analysis

Scenario 7 - Hybrid OBIGGS, HCWT only, Large and Medium Transports, Membrane Systems, & Small Transports, PSA/Membrane Systems

US-Operator

Study period from Rule effect 4th Quarter 2004 thru 2020

Total $ Cost with Inflation	$	9,344,229,343
NPV in 2005 of Cost	$	4,457,094,035
Total Benefits	$	200,022,436
NPV in 2005 of Benefits	$	73,401,100



Fuel Tank Inerting Harmonization Working Group

Sensitivity Analysis

Sensitivity Analysis Conclusions

- Every attempt was made to fairly represent the technical requirements, safety benefits, regulatory matters and estimated costs.

- The baseline cost-benefit analysis represents a balanced approach to the uncertainties in the study assumptions.

- None of the effects, or combinations of effects, evaluated in the sensitivity analysis were sufficient to change the study's overall conclusions or recommendations.

Conclusions

- The conclusions of this study were reached by general consensus.
- After extensive efforts by many industry experts, the Working Group did not find a practical, timely, and cost-effective inerting system concept.
- Using methodology patterned after the FAA's economic analysis practices, the FTIHWG found that none of the systems produced benefits that were reasonably balanced by their costs.
- Because this study was unable to identify an inerting design concept that met the FAA's regulatory evaluation requirements, the FTIHWG concluded that they could not recommend regulatory text based on the flammability level of an inerting system.
- However, this report does include discussion of regulatory issues for the FAA to consider should the FAA propose new regulations based on fuel tank inerting.

Recommendations

The ARAC FTIHWG recommends that the FAA, NASA, and industry expeditiously carry out the following actions:

- Investigate means to achieve a practical onboard fuel tank inerting system design concept for future new type design airplanes.
- Pursue technological advancements that would decrease the complexity, size, weight, and electrical power requirements, and increased efficiency, reliability, and maintainability of onboard inerting system concepts.
- Perform NEA membrane research to improve the efficiency and performance of membranes resulting in lower cost NEA membrane air-separation systems.

Recommendations

- Conduct basic research into high-efficiency, vacuum-jacketed heat exchangers, and lighter, more efficient cryogenic refrigerators for use in inerting systems.

- If a practical fuel tank inerting system is developed, establish a corresponding minimum flammability level and reevaluate and propose regulatory texts and guidance materials accordingly.

Recommendations

- Evaluate means to reduce fuel tank flammability based on existing (e.g., directed ventilation, insulation) or new technology that might be introduced sooner than an inerting system.

- Initiate a project to improve and substantiate current flammability and ignitability analyses to better predict when airplane fuel tank ullage mixtures are flammable. This research is needed to support informed design decisions and rulemaking.

- Initiate a project to thoroughly document and substantiate the flammability model used in this study.

Co-Chair Recommendations

Examples of alternative flammability reductions methods using the ARAC fleet-wide flammability exposure model

Percent Exposure of Airplane Types

Airplane Configuration	LARGE	MEDIUM	SMALL
Baseline	**36.2**	**23.5**	**30.6**
Duct Insulation	[illegible]	**[illegible]9**	**23.9**
Ground Cart Cooling	**26.7**	**16.9**	**20.2**
Duct Insulation & Ground Carts	**18.5**	**12.3**	**16.2**
Reduced Residual Fuel	**33.5**	**20.0**	**27.4**
Duct Insulation with Reduced Residual Fuel	**23.8**	**16.3**	**22.7**
Ground Cart Cooling with Reduced Residual Fuel	**23.4**	**13.1**	**19.2**
Duct Insul & Grd Carts w/ Reduced Residual Fuel	**15.9**	**10.0**	**15.2**

Conclusion: The flammability model results show that a combination of hardware and procedure changes may [illegible]ut fuel tank flammability exposure by more than half. Note, this information was discussed by the working group but inadvertently left out of the final report.

Co-Chair Recommendations

These alternative flammability reduction methods were not studied as a part of this Inerting ARAC, and thus implementation times and costs are not available. However, it is likely that ECS pack bay insulation, wide use of ground air sources, and reduced unusable fuel could be implemented in a majority of the fleet with heated center wing tanks sooner and at lower cost than an inerting system. Some of these features are already being utilized on some airplane models today.

Issued in Hawthorne, California on Thursday, June 21, 2001.

Herman C. Bliss,

Manager, Airports Division, Western-Pacific Region, AWP–600.

[FR Doc. 01–16608 Filed 6–29–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Executive Committee of the Aviation Relemaking Advisory Committee; Meeting

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of meeting.

SUMMARY: The FAA is issuing this notice to advise the public of a meeting of the Executive Committee of the Federal Aviation Administration Aviation Rulemaking Advisory Committee.

DATES: The meeting will be held August 8, 2001, at 10 a.m.

ADDRESSES: The meeting will be held at the Federal Aviation Administration, 800 Independence Ave., SW., Room 1014, Washington, DC 20591.

FOR FURTHER INFORMATION CONTACT: Gerri Robinson, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591, telephone (202) 267–9678; fax (202) 267–5075; e-mail Gerri.Robinson@faa.gov.

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92–463; 5 U.S.C. App. II), notice is hereby given of a meeting of the Executive Committee to be held on August 8, 2001, at the Federal Aviation Administration, 800 Independence Ave., SW., Room 1014, Washington, DC 20591. The agenda will include:

- Fuel Tank Inerting Working Group report
- Nominations for Vice Chair
- Status reports from Assistant Chairs

The Fuel Tank Inerting Working Group plans to request ARAC approval of its report on recommended regulatory text for new rulemaking and the data needed to evaluate the options for implementing new regulations that would require eliminating or significantly reducing the development of flammable vapors in fuel tanks on in-service, new production, and new type design transport category airplanes.

Attendance is open to the interested public but will be limited to the space available. The FAA will arrange teleconference capability for individuals wishing to participate by teleconference if we receive that notification by July 27, 2001. Arrangements to participate by teleconference can be made by contacting the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Callers outside the Washington metropolitan area will be responsible for paying long distance charges.

The public must make arrangements by July 27 to present oral statements at the meeting. The public may present written statements to the executive committee at any time by providing 25 copies to the Executive Director, or by bringing the copies to the meeting.

If you are in need of assistance or require a reasonable accommodation for this meeting, please contact the person listed under the heading **FOR FURTHER INFORMATION CONTACT.**

Issued in Washington, DC, on June 21, 2001.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 01–16476 Filed 6–29–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Notice of Intent To Rule on Application To Impose and Use the Revenue From a Passenger Facility Charge (PFC) at Dane County Regional Airport, Madison, WI

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of intent to rule on application.

SUMMARY: The FAA proposes to rule and invites public comment on the application to impose and use the revenue from a PFC at Dane County Regional Airport under the provisions of the Aviation Safety and Capacity Expansion Act of 1990 (Title IX of the Omnibus Budget Reconciliation Act of 1990) (Public Law 101–508) and Part 158 of the Federal Aviation Regulations (14 CFR Part 158).

DATES: Comments must be received on or before August 1, 2001.

ADDRESSES: Comments on this application may be mailed or delivered in triplicate to the FAA at the following address: Minneapolis Airports District Office, 6020 28th Avenue South, Room 102, Minneapolis, Minnesota 55450. In addition, one copy of any comments submitted to the FAA must be mailed or delivered to Peter L. Drahn, Airport Director of Dane County Regional Airport, Madison, Wisconsin at the following address: 4000 International Lane, Madison, Wisconsin 53704–3120.

Air carriers and foreign air carriers may submit copies of written comments previously provided to the County of Dane under section 158.23 of Part 158.

FOR FURTHER INFORMATION CONTACT: Sandra E. DePottey, Program Manager, Airports District Office, 6020 28th Avenue South, Room 102, Minneapolis, Minnesota 55450, 612–713–4363. The application may be reviewed in person at this same location.

SUPPLEMENTARY INFORMATION: The FAA proposes to rule and invites public comment on the application to impose and use the revenue from a PFC at Dane County Regional Airport under the provisions of the Aviation Safety and Capacity Expansion Act of 1990 (Title IX of the Omnibus Budget Reconciliation Act of 1990) (Public Law 101–508) and part 158 of the Federal Aviation Regulations (14 CFR part 158).

On May 31, 2001 the FAA determined that the application to impose and use the revenue from a PFC submitted by the County of Dane was substantially complete within the requirements of section 158.25 of Part 158. The FAA will approve or disapprove the application, in whole or in part, no later than September 4, 2001.

The following is a brief overview of the application.

PFC application number: 01–05–C–00–MSN.

Level of the proposed PFC: $4.50.

Proposed charge effective date: December 1, 2006.

Proposed charge expiration date: March 1, 2014.

Total estimated PFC revenue: $46,656,115.00.

Brief description of proposed projects: Realignment of taxiway "E" at east ramp, terminal apron expansion, terminal building expansion, airfield storm water study and improvements.

Class or classes of air carriers which the public agency has requested not be required to collect PFCs: Air taxi/commercial operators filing FAA form 1800–31. Any person may inspect the application in person at the FAA office listed above under **FOR FURTHER INFORMATION CONTACT**. In addition, any person may, upon request, inspect the application, notice and other documents germane to the application in person at Dane County Regional Airport.

Region, 1601 Lind Avenue, SW., Renton, Washington 98055, (425) 227–2589, *charles.huber@faa.gov*.

SUPPLEMENTARY INFORMATION:

Background

The FAA established the Aviation Rulemaking Advisory Committee to provide advice and recommendations to the FAA Administrator on the FAA's rulemaking activities with respect to aviation-related issues. This includes obtaining advice and recommendations on the FAA's commitments to harmonize Title 14 of the Code of Federal Regulations (14 CFR) with its partners in Europe and Canada.

The Task

1. Review the proposed guidance of Advisory Circular, Joint 25.603 paragraph 9 and Advisory Material Joint 25.603 (adopted in Joint Aviation Requirements—25 Change 15, resulting from Notice of Proposed Amendment 25D–256).

2. Develop a report based on the review and recommend the adoption of harmonized guidance material for paragraph 25.603 of the JAR and § 25.603 of the FAR.

3. During the development of the guidance, if there is a need to make regulatory changes, provide the appropriate rulemaking text (as well as cost estimates—responding to economic questions).

4. If as a result of the recommendations, the FAA publishes an NPRM and/or notice of availability of proposed advisory circular for public comment, the FAA may ask ARAC to review all comments and provide the agency with a recommendation for the disposition of those comments.

Schedule: This task is to be competed no later than February 24, 2003.

ARAC Acceptance of Task

ARAC accepted the task and assigned the task to the General Structures Harmonization Working Group, Transport Airplane and Engine Issues. The working group serves as staff to ARAC and assists in the analysis of assigned tasks. ARAC must review and approve the working group's recommendations. If ARAC accepts the working group's recommendations, it will forward them to the FAA.

Working Group Activity

The General Structures Harmonization Working Group is expected to comply with the procedures adopted by ARAC. As part of the procedures, the working group is expected to:

1. Recommend a work plan for completion of the task, including the rationale supporting such a plan for consideration at the next meeting of the ARAC on transport airplane and engine issues held following publication of this notice.

2. Give a detailed conceptual presentation of the proposed recommendations prior to proceeding with the work stated in item 3 below.

3. Draft the appropriate documents and required analyses and/or any other related materials or documents.

4. Provide a status report at each meeting of the ARAC held to consider transport airplane and engines issues.

Participation in the Working Group

The General Structures Harmonization Working Group is composed of technical experts having an interest in the assigned task. A working group member need not be a representative or a member of the full committee.

An individual who has expertise in the subject matter and wishes to become a member of the working group should write to the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing his or her interest in the task, and stating the expertise he or she would bring to the working group. All requests to participate must be received no later than August 31, 2001. The requests will be reviewed by the assistant chair, the assistant executive director, and the working group co-chairs. Individuals will be advised whether or not their request can be accommodated.

Individuals chosen for membership on the working group will be expected to represent their aviation community segment and actively participate in the working group (e.g., attend all meetings, provide written comments when requested to do so, etc.). They also will be expected to devote the resources necessary to support the working group in meeting any assigned deadlines. Members are expected to keep their management chain and those they may represent advised of working group activities and decisions to ensure that the proposed technical solutions do not conflict with their sponsoring organization's position when the subject being negotiated is presented to ARAC for approval.

Once the working group has begun deliberations, members will not be added or substituted without the approval of the assistant chair, the assistant executive director, and the working group co-chairs.

The Secretary of Transportation determined that the formation and use of the ARAC is necessary and in the public interest in connection with the performance of duties imposed on the FAA by law.

Meetings of the ARAC will be open to the public. Meetings of the General Structures Harmonization Working Group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. The FAA will make no public announcement of working group meetings.

Issued in Washington, DC, on July 30, 2001.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 01–19644 Filed 8–6–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Executive Committee of the Aviation Rulemaking Advisory Committee—Meeting Location Change

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of change in meeting location for the Executive Committee of the Aviation Rulemaking Advisory Committee (ARAC).

SUMMARY: The FAA is issuing this notice to advise the public of a change in the meeting location of the Executive Committee of the Federal Aviation Administration Aviation Rulemaking Advisory Committee.

DATES: The meeting will be held August 8, 2001, at 10 a.m.

ADDRESSES: The Holiday Inn—Capitol, 550 C Street, SW., Washington, DC 20024, Columbia Room.

FOR FURTHER INFORMATION CONTACT: Gerri Robinson, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591, telephone (202) 267–9678; fax (202) 267–5075; e-mail *Gerri.Robinsin@faa.gov*.

SUPPLEMENTARY INFORMATION: The Executive Committee meeting location has been changed from the Federal Aviation Administration in Washington, DC, to the Holiday Inn—Capitol, 550 C Street, SW., Washington, DC 20024, Columbia Room. Please see the **Federal Register** notice published on July 2, 2001, (66 FR 34982) for additional information regarding the meeting.

Issued in Washington, DC, on August 1, 2001.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 01–19704 Filed 8–2–01; 3:27 pm]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

RTCA Government/Industry Certification Steering Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of RTCA Government/Industry Certification Steering Committee meeting.

SUMMARY: The FAA is issuing this notice to advise the pubic of a meeting of the RTCA Government/Industry Certification Steering Committee.

DATES: The meeting will be held August 31, 2001, from 8 am–12 pm.

ADDRESSES: The meeting will be held at FAA Headquarters, 800 Independence Avenue, SW, Bessie Coleman Conference Center, Room 2 AB, Washington, DC, 20591.

FOR FURTHER INFORMATION CONTACT: RTCA Secretariat, 1828 L Street, NW., Suite 805, Washington, DC. 20036; telephone (202) 833–9339; fax (202) 833–9434; web site *http://www.rtca.org.*

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (Pub. L. 92–463, 5 U.S.C., Appendix 2), notice is hereby given for a Certification Steering Committee meeting. The agenda will include:

August 31

- Opening Session (Welcome and Introductory Remarks)
- Certification Select Committee Report
- Final Reports on Implementation of Task Force 4 Recommendations
- Closing Session (Other Business, Adjourn)

Attendance is open to the interested public but limited to space availability. With the approval of the chairmen, members of the public may present oral statements at the meeting. Persons wishing to present statements or obtain information should contact the person listed in the **FOR FURTHER INFORMATION CONTACT** section. Members of the public may present a written statement to the committee at any time.

Issued in Washington, DC, on August 1, 2001.

Janice L. Peters,

FAA Special Assistant, RTCA Advisory Committee.

[FR Doc. 01–19737 Filed 8–6–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

RTCA Future Flight Data Collection Committee

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of RTCA Future Flight Data Collection Committee meeting.

SUMMARY: The FAA is issuing this notice to advise the public of a meeting of the RTCA Future Flight Data Collection Committee.

DATES: The meeting will be held September 11, 2001 starting at 9 am.

ADDRESSES: The meeting will be held at RTCA, Inc., 1828 L Street, NW, Suite 805, Washington, DC, 20036.

FOR FURTHER INFORMATION CONTACT: RTCA Secretariat, 1828 L Street, NW., Suite 805, Washington, DC, 20036; telephone (202) 833–9339; fax (202) 833–9434; web site http://www.rtca.org.

SUPPLEMENTARY INFORMATION: Pursuant to section 10(a)(2) of the Federal Advisory Committee Act (P.L. 92–463, 5 U.S.C., Appendix 2), notice is hereby given or a Future Flight Data Collection Committee meeting. The agenda will include:

September 11

- Opening Session (Welcome, Introductions, Administrative Remarks, Agenda Review, Review/Approve Summary of Previous Meeting)
- Review and Approve Final Draft Document
- Closing Session (Other Business, Adjourn)

Attendance is open to the interested public but limited to space availability. With the approval of the chairmen, members of the public may present oral statement at the meeting. Persons wishing to present statements or obtain information should contact the person listed in **FOR FURTHER INFORMATION CONTACT** section. Members of the public may present a written statement to the committee at any time.

Issued in Washington, DC, on August 2, 2001.

Janice L. Peters,

FAA Special Assistant, RTCA Advisory Committee.

[FR Doc. 01–19738 Filed 8–6–01; 8:45 am]

BILLING CODE 4910–13–M

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Notice of Passenger Facility Charge (PFC) Approvals and Disapprovals

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Monthly Notice of PFC Approvals and Disapprovals. In June 2001, there were 10 applications approved. This notice also includes information on one application, approved in May 2001, inadvertently left off the May 2001 notice. Additionally, 16 approved amendments to previously approved applications are listed.

SUMMARY: The FAA publishes a monthly notice, as appropriate, of PFC approvals and disapprovals under the provisions of the Aviation Safety and Capacity Expansion Act of 1990 (Title IX of the Omnibus Budget Reconciliation Act of 1990) (Public Law 101–508) and Part 158 of the Federal Aviation Regulations (14 CFR Part 158). This notice is published pursuant to paragraph d of § 158.29.

PFC Applications Approved

Public Agency: Airport Authority of Washoe County, Reno, Nevada.

Application Number: 01–04–C–00–RNO.

Application Type: Impose and use a PFC.

PFC Level: $4.50.

Total PFC Revenue Approved in This Decision: $16,136,466.

Earliest Charge Effective Date: August 1, 2001.

Estimated Charge Expiration Date: February 1, 2003.

Class of Air Carriers Not Required To Collect PFC's: Nonscheduled/on-demand air carriers filing FAA Form 1800–31.

Determination: Approved. Based on information contained in the public agency's application, the FAA has determined that the proposed class accounts for less than 1 percent of the total annual enplanements at Reno/Tahoe International Airport.

Brief Description of Project Approved for Collection at a $4.50 PFC Level: Southern portion of southwest air cargo ramp.